Alberta Regeneration

Survey Manual

Effective
May 1, 2003

Alberta Sustainable Resource Development

Forest Management Branch

Edmonton, Alberta, Canada

Alberta
SUSTAINABLE RESOURCE
DEVELOPMENT

Publication Number: Ref. 70 T/045

ISBN N0. 0-7785-2908-8 (Printed Edition)
ISBN N0. 0-7785-2909-6 (On-line Edition)

Date Printed: May, 2003

This document may be found on the Alberta Sustainable Resource Development website: www3.gov.ab.ca/srd/forests/fmd/manuals/index.html

For copies of this report, contact:

Information Centre
Alberta Sustainable Resource Development
Main Floor, Great West Life Building
9920 108 Street
Edmonton, Alberta, Canada T5K 2M4

Telephone: (780) 427-2079

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Introduction

1.1 General

In 1991, the legislative requirements for forest regeneration were amended to reflect an improved understanding and increased forest industry accountability for reforestation. At that time, a commitment was made to review the application and applicability of the new Alberta reforestation standard. A review of the standards by the Regeneration Survey Task Force, consisting of both industry and government, was concluded in March 2000 with the adoption of the "2000 Regeneration Standards".

A review of the Free-to-Grow (FTG) standards of the Performance Survey was completed in April of 2003. Several changes to the survey protocol and the FTG criteria were made to enable the retention of greater levels of vegetation adjacent to conifer crop trees that are growing well. These revised standards were adopted effective May 01, 2003.

The purpose of the Regeneration Standards is to ensure:

- Prompt reforestation following harvest
- Adequate stocking, survival and growth rates
- A level of performance that emulates natural yields found in Alberta's forests

Alberta's reforestation standards are expressed as measurable criteria that assess if forest establishment and performance objectives have been met. This manual provides the regeneration standards and survey procedures that are to be used to determine levels of regrowth and performance of desirable tree species on harvested or otherwise denuded forested lands.

1.1.1 Organization of the Manual

A surveyor deals with one standard for a cutblock or strata, depending on the years since harvest (Establishment or Performance) and the strata standard (C, CD, DC, or D) as

described in Section 1.2. The manual is, therefore, organized so that all the information on strata standards for the particular survey is located in a single section. The Wet, Low Density Standard is included separately in Section 4.0.

The field procedures and administrative requirements, which are common to all surveys, are detailed in Section 5.0 through 7.0. The Appendix includes a glossary, additional detail on procedures, as well as some forms and examples.

1.2 Strata Standards

The 2000 Regeneration Standards continue to incorporate density, height and "Free-to Grow" status (see Glossary and Section 3.0), as well as a minimum stocking standard. Under these updated standards, forest operators will be expected to reforest to one of four "strata standards". These strata standards are: Coniferous (C), Coniferous-Deciduous (CD), Deciduous-Coniferous (DC), and Deciduous (D).

1.3 Types of Surveys

1.3.1 Establishment and Performance Surveys

The 2000 Regeneration Standards utilize two independent surveys with timelines for delivery as follows:

1. An Establishment Survey completed 4 to 8 years after harvesting in C, CD and DC cutblocks or strata; and 3 to 5 years after harvesting in D cutblocks or strata.

2. A Performance Survey completed 8 to 14 years after harvesting in C, CD, and DC cutblocks or strata; and 10 to 14 years after harvesting in conditionally stocked D cutblocks or strata.

The Establishment Survey will show stocking amount (percent), density (stems/ha) and early growth of regenerated trees, as well as the approximate locations of satisfactorily restocked (SR) and/or not satisfactorily restocked (NSR) areas larger than 4 ha.

The Performance Survey will measure the same variables as the Establishment Survey, however, to different standards, and in addition will identify coniferous crop trees deemed Free-to Grow or else in need of stand cleaning.

1.4 Applicability

Regeneration surveys conducted on all public lands within the Province of Alberta for the purpose of fulfilling obligations under the Timber Management Regulation are to be carried out according to procedures provided in this manual unless otherwise specified by the Minister of Alberta Sustainable Resource Development. Details on related policies and aspects of enforcement may be described in directives posted or otherwise distributed by Alberta Sustainable Resource Department.

1.4.1 Strata Balancing Requirement

In conjunction with the requirements of the Reforestation Standard as outlined in this manual, the timber operator that is responsible to meet the Reforestation Standard is also responsible to meet the provisions set out in a series of Land and Forest Division (LFD) Directives referred to as the "Strata Balancing" Directives. These directives are: Directive # 2001-02: Maintaining 1991 Reforestation Strata; Directive # 2001-03: Balancing Reforestation Standards By Overstory Cover Group; Directive # 2001-04: Re-designation of Reforestation Strata. Contained within each of these documents are the parameters and guidelines which articulate the expectations and responsibilities of those timber operators to which these apply. Copies of these Directives can be found on the Alberta Sustainable Resource Development website: **www3.gov.ab.ca/srd/forests/fmd/directives/index.html.**

1.4.2 Alternative Survey Standards and Methods

Notwithstanding the standards presented in this manual, alternative regeneration standards may be used where approved by the Land and Forest Division. The forest operator must receive approval before employing survey methods that are contrary to those described in this manual.

1.5 Authority

Regeneration surveys are required to be conducted under the authority of the Timber Management Regulation, Part 6, Reforestation, specifically Section 141.2. Timing and delivery of surveys is also specified in the Timber Management Regulation.

1.6 Qualifications of Surveyors

Under the authority of Section 141.3 of the Timber Management Regulation, the Minister requires that in order for a regeneration survey to be acceptable, a certified regeneration surveyor must be the principal participant in the field survey.

A **certified regeneration surveyor** is a person who:

1. has successfully completed the current government sanctioned training course(s), and
2. has met the field experience requirement of satisfactory **principal participation** in five (5) field surveys, and
3. had received a certification number, and
4. the certification is valid at the time of survey.

In order to be considered a **principal participant** in the field survey, the certified surveyor must certify the accuracy and completeness of the survey by entering the certification number on the survey form.

2.0 Establishment Survey Standards

2.1 Coniferous Standard (C)

2.1.1 Timing of Survey

The Establishment Survey must be carried our no sooner than 4 years and no later than 8 years after harvesting is completed.

2.1.2 Stocking

The basic sampling unit is a ten square meter, circular plot 1.78 meters in radius. This sample plot is considered stocked if it contains at least one **crop tree** which meets the species and height parameters in Tables 2.2 and 2.3.

A cutblock being reforested to a coniferous (C) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportion specified in Table 2.1:

Table 2.1

Cutblock	Minimum Conifer Stocking	Minimum Deciduous Stocking	Minimum Total Cutblock Stocking
Areas harvested March 1, 1991 to April 30, 2000	70%	0%	80%
Areas harvested After May 1, 2000 in Subalpine, Montane, & Upper Foothills	80%	0%	80%

Table 2.1

Cutblock	Minimum Conifer Stocking	Minimum Deciduous Stocking	Minimum Total Cutblock Stocking
Areas harvested After May 1, 2000 in Lower Foothills, Central Mixedwood, Dry Mixedwood, Wetland Mixedwood, & Boreal Highlands	70%	0%	80%

2.1.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

2.1.3.1 Crop tree species

Table 2.2 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 2.2

Crop tree species including advance growth
for areas being reforested to a coniferous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

2.1.3.2 Crop tree height

Table 2.3 details the minimum height requirements for a crop tree on areas being reforested to a coniferous standard.

Table 2.3

Crop tree establishment height requirements for areas being reforested to a coniferous standard.

Natural sub-region	Minimum conifer Crop tree height (cm)	Minimum deciduous Crop tree height (cm)
Central Mixedwood, Boreal Highlands, Dry Mixedwood, Wetland Mixedwood, & Lower Foothills	30	120
Subalpine, Montane, & Upper Foothills	30	80

2.2 Coniferous-Deciduous Standard (CD)

2.2.1 Timing of Survey

The Establishment Survey must be carried out no sooner than 4 years and no later than 8 years after harvesting is completed.

2.2.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one **crop tree** which meets the species and height parameters in Tables 2.5 and 2.6.

A cutblock being reforested to a coniferous-deciduous (CD) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 2.4.
In order to meet the minimum proportions of coniferous and deciduous outlined in Table 2.4, the use of "overlapping plots" is permitted.

Table 2.4

Cutblock	Minimum Conifer Stocking *	Minimum Deciduous Stocking*	Minimum Total Stocking
Areas harvested March 1, 1991 to April 30, 2000	50%	10%	80%
Areas harvested After May 1, 2000	50%	30%	80%

* The term "overlapping plot" means you are allowed to count the same plot twice in the calculation required to meet the minimum species proportions shown in Table 2.4, given that the plot actually contains a coniferous and a deciduous crop tree. The "overlapping plot" is considered SR and will only count once in the total cutblock stocking calculation.

2.2.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

2.2.3.1 Crop tree species

Table 2.5 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a coniferous-deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 2.5

Crop tree species including advance growth
for areas being reforested to a coniferous-deciduous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *

Coniferous Species	Deciduous Species
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

2.2.3.2 Crop tree height

Table 2.6 details the minimum height requirements for a crop tree on areas being reforested to a coniferous-deciduous standard.

Table 2.6

Crop tree establishment height requirements for areas being reforested to a coniferous-deciduous standard.

Natural sub-region	Minimum conifer Crop tree height (cm)	Minimum deciduous Crop tree height (cm)
Central Mixedwood, Boreal Highlands, Dry Mixedwood, Wetland Mixedwood, & Lower Foothills	30	120
Subalpine, Montane, & Upper Foothills	30	80

2.3 Deciduous -Coniferous Standard (DC)

2.3.1 Timing of Survey

The Establishment Survey must be carried out no sooner than 4 years and no later than 8 years after harvesting is completed.

2.3.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one **crop tree** which meets the species and height parameters in Tables 2.8 and 2.9.

A cutblock being reforested to a deciduous-coniferous (DC) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 2.7.
In order to meet the minimum proportions of coniferous and deciduous outlined in Table 2.7, the use of "overlapping plots" is permitted.

Table 2.7

Cutblock	Minimum Conifer Stocking *	Minimum Deciduous Stocking*	Minimum Total Stocking
Areas harvested March 1, 1991 to April 30, 2000	30%	30%	80%
Areas harvested After May 1, 2000 in	30%	50%	80%

* The term "overlapping plot" means you are allowed to count the same plot twice in the calculation required to meet the minimum species proportions shown in Table 2.7, given that the plot actually contains a coniferous and a deciduous crop tree. The "overlapping plot" is considered SR and will only count once in the total cutblock stocking calculation.

2.3.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

2.3.3.1 Crop tree species

Table 2.8 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a deciduous-coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 2.8

Crop tree species including advance growth
for areas being reforested to a deciduous-coniferous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *

Coniferous Species	Deciduous Species
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

2.3.3.2 Crop tree height

Table 2.9 details the minimum height requirements for a crop tree on areas being reforested to a deciduous-coniferous standard.

Table 2.9

Crop tree establishment height requirements for areas being reforested to a deciduous-coniferous standard.

Sub-region	Minimum conifer Crop tree height (cm)	Minimum deciduous Crop tree height (cm)
Central Mixedwood, Boreal Highlands, Dry Mixedwood, Wetland Mixedwood, & Lower Foothills	30	120
Subalpine, Montane, & Upper Foothills	30	80

2.4 Deciduous Standard (D)

2.4.1 Timing of Survey

The Establishment Survey must be carried out no sooner than 3 years and no later than 5 years after harvesting is completed.

2.4.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one **crop tree,** or at least one conditional coniferous tree which meets the species and height parameters in Tables 2.11 and 2.12.

A cutblock being reforested to a deciduous (D) standard will be considered satisfactorily restocked (SR) when:

a) 80% or more of the sample plots are stocked with at least one deciduous crop tree or one conditional coniferous tree and at least 60% are stocked with at least one deciduous crop tree (as outlined in Table 2.10), and;

b) The portion of plots stocked with conditional coniferous trees does not exceed 20%, and;

c) The average number of deciduous crop trees per plot on the cutblock must be equal to or greater than the average number of deciduous crop trees by subregion and drainage class (Table 2.12), and the minimum average height of deciduous crop trees is met (Table 2.12)

Table 2.10

Cutblock	Minimum Conifer Stocking	Minimum Deciduous Stocking	Minimum Total Stocking *
Areas harvested March 1, 1991 to April 30, 2000	0%	60%	80%
Areas harvested After May 1, 2000	0%	60%	80%

* The portion of plots stocked with conditional coniferous trees may not exceed 20% for SR blocks.

2.4.2.1 Conditionally restocked areas

An area which is to be reforested to deciduous standards will be considered **conditionally restocked** when according to the definitions below, there are either:

a) Low average number of deciduous crop trees:

- 80% or more of the sample plots are stocked with at least one deciduous crop tree, and;
- the average height of deciduous crop trees on the cutblock is greater than or equal to the average height of deciduous crop trees by subregion, ecosite, and drainage class (Table 2.12), and;
- the average number of deciduous crop trees per plot on the cutblock is less than the average number of deciduous crop trees by subregion, ecosite, and drainage class (Table 2.12).

OR

b) Greater than 20% conditional coniferous trees:

- 80% or more of the sample plots are stocked with at least one deciduous crop tree or at least one conditional coniferous tree. The portion of plots stocked with conditional coniferous trees exceeds 20%, and;
- the average height of deciduous crop trees on the cutblock is greater than or equal to the average height of deciduous crop trees by subregion, ecosite, and drainage class (Table 2.12), and;
- the average number of deciduous crop trees per plot on the cutblock is greater than or equal to the average number of deciduous crop trees by subregion, ecosite, and drainage class (Table 2.12).

OR

c) Low average number of deciduous crop trees and more than 20% conditional coniferous trees:

- 80% or more of the sample plots are stocked with at least one deciduous crop tree or at least one conditional coniferous tree. The portion of plots stocked with conditional coniferous trees exceeds 20%, and;
- the average height of deciduous crop trees on the cutblock is greater than or equal to the average height of deciduous crop trees by subregion, ecosite, and drainage class (Table 2.12), and;
- the average number of deciduous crop trees per plot on the cutblock is less than the average number of deciduous crop trees by subregion, ecosite, and drainage class (Table 2.12).

2.4.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for at least three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

A **conditional coniferous** tree is a specific tree of acceptable species which has achieved the minimum height requirement specified in Table 2.12 for conditional coniferous trees but has not achieved the minimum **crop tree** height. It is alive, healthy and undamaged, and has grown on-site for a minimum of three years.

Table 2.11 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 2.11

Crop tree species including advance growth
for areas being reforested to a deciduous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

2.4.3.1 Crop tree height and density

Table 2.12 provides the minimum heights and numbers of trees for various species groups and sites as required to meet deciduous establishment standards.

Table 2.12

Crop tree establishment height requirements for areas being reforested to a deciduous standard.

Natural Sub-region	Species	Drainage Class	Ecosite*	Minimum crop tree height (cm)	Minimum average height of acceptable deciduous trees **	Minimum average number of acceptable deciduous per plot ***	Minimum height of conditional coniferous trees
Central Mixedwood, Dry Mixedwood, Wet Mixedwood	Sw, Sb, Fb, Fa	VR, R, W, MW, & I	A – E	80	n/a	n/a	30
		P & VP	F - H	80	n/a	n/a	30
	Pl, Pj, Lt	VR, R, W, MW & I	A – E	160	n/a	n/a	60
		P & VP	F - H	160	n/a	n/a	60
	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	80	160	7.0	n/a
		P & VP	F - H	80	120	5.0	n/a
Boreal Highlands	Sw, Sb, Fb, Fa	VR, R, W, MW, & I	A – E	80	n/a	n/a	30
		P & VP	F - G	80	n/a	n/a	30

Boreal Highlands (cont.)	Pl, Pj, Lt	VR, R, W, MW, & I	A – E	160	n/a	n/a	60
		P & VP	F - G	160	n/a	n/a	60
	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	80	160	7.0	n/a
		P & VP	F - G	80	120	5.0	n/a
Montane	Sw, Se, Sb, Fd, Fa	VR, R, W, MW, & I	A – E (A - F)	80	n/a	n/a	30
		P & VP	F – G (G)	80	n/a	n/a	30
	Pf, Pl, La	VR, R, W, MW, & I	A – E (A - F)	160	n/a	n/a	60
		P & VP	F – G (G)	160	n/a	n/a	60
	Aw, Pb, Bw	VR, R, W, MW, & I	A – E (A - F)	50	100	7.0	n/a
		P & VP	F – G (G)	50	75	5.0	n/a
Lower Foothills	Sw, Sb, Fb, Fa	VR, R, W, MW, & I	A – E	80	n/a	n/a	30
		P & VP	F - H	80	n/a	n/a	30
	Pl, Pt	VR, R, W, MW, & I	A – E	160	n/a	n/a	60
		P & VP	F - H	160	n/a	n/a	60
	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	80	140	7.0	n/a
		P & VP	F - H	80	100	5.0	n/a
Upper Foothills****	Sw, Se, Sb, Fa	VR, R, W, MW, & I	A – F, (A – E)	80	n/a	n/a	30
		P & VP	G – J, (F – H)	80	n/a	n/a	30
	Pl, Pt	VR, R, W, MW, & I	A – F, (A – E)	160	n/a	n/a	60
		P & VP	G – J, (F – H)	160	n/a	n/a	60
	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	50	100	7.0	n/a
		P & VP	G – J, (F – H)	50	75	5.0	n/a

* **Ecosites in brackets** are from the Field guide to Ecosites of South Western Alberta, whereas the other ecosites are from the Field Guide to Ecosites of West Central Alberta and the Field Guide to Ecosites of Northern Alberta for the appropriate Natural Subregions. THESE ARE DETERMINED BEFORE HARVEST ONLY.

** **The average height of acceptable deciduous trees** is the arithmetic mean of the tallest deciduous tree from each plot in the cutblock stocked to deciduous species, excluding advance growth and those plots contributing to the declared conifer stocking percentage.

*** **The average number of acceptable deciduous trees** is the arithmetic mean of the number of acceptable deciduous trees from all plots (deciduous and nil tally plots), excluding those plots that are stocked to coniferous trees. In each stocked plot, the maximum number of acceptable deciduous trees that may be used in the calculation is 10.

**** **In the Upper Foothills Subregion the deciduous strata standard will only be allowed where the previous stand type was DC or D.**

3.0 Performance Survey Standards

3.1 Coniferous Standard (C)

3.1.1 Timing of Survey

The Performance Survey must be carried out no sooner than 8 years and no later than 14 years after harvesting is completed and must not be completed within 2 growing seasons after a stand tending treatment is completed.

It is possible to use one survey visit to collect the data required for both the Establishment Survey and Performance Surveys, providing the survey is done in year 8, so that the minimum and maximum timing parameters are met for both types of surveys provided the 2 growing season treatment rule is observed.

3.1.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one crop tree which meets the species, height and other characteristics in Tables 3.2, 3.3, and 3.4.

A cutblock being reforested to a coniferous (C) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 3.1.

Table 3.1

Cutblock	Minimum Conifer Stocking	Minimum Deciduous Stocking	Minimum Total Cutblock Stocking
Areas harvested March1, 1991 to April 30, 2000	70%	0%	80%
Areas harvested After May 1, 2000 in Subalpine, Montane, & Upper Foothills	80%	0%	80%
Areas harvested After May 1, 2000 in Lower Foothills, Central Mixedwood, Dry Mixedwood, Wetland Mixedwood, & Boreal Highlands	70%	0%	80%

3.1.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species.

Under the Performance Survey, and in addition to the above criteria, both coniferous seedlings and coniferous advance growth must meet the criteria of **Free-to-Grow** in order to be considered as a crop tree. There is no Free-to-Grow requirement for deciduous species. Within the Free-to-Grow definition, any broadleaved vegetation is deemed to be a competitor tree/shrub (other than mature residual deciduous trees) based on the following rules:

For surveys conducted between 8-11 years after harvest:

1. Any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and
2. That is equal to or greater than 2/3 the crop tree height

For surveys conducted between 12-14 years after harvest;

1. Any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and
2. That is equal to or greater than the crop tree height, and,
3. With a base diameter equal to or greater than 70% of the conifer crop tree root collar diameter.

Conifer crop trees with no competing vegetation within the 1.78 m cylinder are considered to have met the Free-to-Grow criteria. Conifer crop trees with competitors within the cylinder and that meet specified performance criteria are considered to be provisionally FTG according to the details provided in the following table:

Species	Performance Indicators	Allowable area of cylinder with competitors
Spruces, firs	Last 2 year leader increment => 60 cm OR total height => 2.5m	Competitor trees/shrubs in one or two of four quadrants
Pines, larches	Height:diameter ratio < 0.55 OR total height =>3.5m	Competitor trees/shrubs in one of four quadrants

Provisionally FTG plots may be used in the calculation of the required minimum stocking levels (Table 3.1) according to the following maximum countable proportions:

Total Provisional	Provisional Spruces	Provisional Pines
30%	30%	10%

Provisionally FTG plots in excess of the allowable limits shown in the above table are considered to be NSR.

3.1.3.1 Crop tree species

Table 3.2 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 3.2

Crop tree species including advance growth
for areas being reforested to a coniferous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per Directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

3.2.3.2 Crop tree height

Table 3.3 details the minimum coniferous performance height requirements for a Free-to-Grow crop tree on areas being reforested to a coniferous standard.

Table 3.3

Coniferous crop tree performance height requirements for areas being reforested to a coniferous standard.

Sub-region (North of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Central Mixedwood Dry Mixedwood Wet Mixedwood	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	150
		P to VP	F – H	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – E	75
		P to VP	F – H	60
	Sw	VR, R, W, MW, &I	A – E	100
		P to VP	F – H	80
Lower Foothills	Pl, Pj, Lt	VR, R, W, MW, &I	A – F (A – E)	150
		P to VP	G – J (F – H)	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	75
		P to VP	G – J (F – H)	60
	Sw	VR, R, W, MW, &I	A – F (A – E)	100
		P to VP	G – J (F – H)	80
Boreal Highlands	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	150
		P to VP	F – G	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – E	75
		P to VP	F – G	60
	Sw	VR, R, W, MW, &I	A – E	100
		P to VP	F – G	80

Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	125
		P to VP	G – J (F – H)	110
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	65
		P to VP	G – J (F – H)	55
	Sw, Se	VR, R, W, MW, &I	A – F (A – E)	85
		P to VP	G – J (F – H)	70
Montane	Pl, Pf	VR, R, W, MW, &I	A – E (A – F)	105
		P to VP	F – G (G)	95
	Sb, Fa	VR, R, W, MW, &I	A – E (A – F)	55
		P to VP	F – G (G)	45
	Fd	VR, R, W, MW, &I	A – E (A – F)	35
	Sw, Se	VR, R, W, MW, &I	A – E (A – F)	70
		P to VP	F – G (G)	60
Subalpine	Pl, Lt, La	VR, R, W, MW, &I	A – D (A – F)	105
		P to VP	E – I (G – H)	95
	Sb, Fa	VR, R, W, MW, &I	A – D (A – F)	55
		P to VP	E – I (G – H)	45
	Sw, Se	VR, R, W, MW, &I	A – D (A – F)	70
		P to VP	E – I (G – H)	60

Sub-region (South of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Lower Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	100
		P to VP	G – J (F – H)	85
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	55
		P to VP	G – J (F – H)	45
	Sw	VR, R, W, MW, &I	A – F (A – E)	75
		P to VP	G – J (F – H)	65
Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	80
		P to VP	G – J (F – H)	70
	Sb, Fa	VR, R, W, MW, &I	A – F (A – E)	55
		P to VP	G – J (F – H)	40
	Sw	VR, R, W, MW, &I	A – F (A – E)	70
		P to VP	G – J (F – H)	60
Montane	Pl, Pf, Lt	VR, R, W, MW, &I	A – E (A – F)	60
		P to VP	F – G (G)	55
	Sb, Fa	VR, R, W, MW, &I	A – E (A – F)	45
		P to VP	F – G (G)	35
	Sw, Se	VR, R, W, MW, &I	A – E (A – F)	65
		P to VP	F – G (G)	55
	Fd	VR, R, W, MW, &I	A – E (A – F)	35

Subalpine	Pl, Pw, Lt, La	VR, R, W, MW, &I	A – D (A – F)	60
		P to VP	E – I (G – H)	55
	Sb, Fa	VR, R, W, MW, &I	A – D (A – F)	45
		P to VP	E – I (G – H)	35
	Sw, Se	VR, R, W, MW, &I	A – D (A – F)	65
		P to VP	E – I (G – H)	55
	Fd	VR, R, W, MW, &I	A –E (A – F)	35

Table 3.4 details the minimum deciduous performance height requirements for a deciduous crop tree on areas being reforested to a coniferous standard.

Table 3.4

Deciduous crop tree performance height requirements for areas being reforested to a coniferous standard

Natural Sub-region	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Central Mixedwood Dry Mixedwood Wet Mixedwood	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	200
		P to VP	F - H	150
Boreal Highlands	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	200
		P to VP	F - G	150
Lower Foothills	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	175
		P to VP	G – J (F – H)	125
Upper Foothills	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	150
		P to VP	G – J (F – H)	115

Montane	Aw, Pb, Bw	VR, R, W, MW, & I	A – E (A – F)	150
		P to VP	F – G (G)	115
Subalpine	Aw, Pb, Bw	VR, R, W, MW, & I	A – D (A – F)	150
		P to VP	E – I (G – H)	115

3.2 Coniferous-Deciduous Standard (CD)

3.2.1 Timing of Survey

The Performance Survey must be carried out no sooner than 8 years and no later than 14 years after harvesting is completed and must not be completed within 2 growing seasons after a stand tending treatment is completed.

It is possible to use one survey visit to collect the data required for both the Establishment Survey and Performance Surveys, providing the survey is done in year 8, so that the minimum and maximum timing parameters are met for both types of surveys provided the 2 growing season treatment rule is observed.

3.2.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one **crop tree** which meets the species, height and other characteristics in Tables 3.6, 3.7, and 3.8.

A cutblock being reforested to a coniferous-deciduous (CD) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 3.5.

In order to meet the minimum proportions of coniferous and deciduous outlined in Table 3.5, the use of "overlapping plots" is permitted. "Overlapping plots" are plots that may be counted twice in the calculation to meet the required minimum species proportions shown in table 3.5, given that the plot contains both a coniferous and a deciduous crop tree. An overlapping plot is considered SR, but may only be counted once in the total cutblock stocking calculation.

Table 3.5

Cutblock	Minimum Conifer Stocking*	Minimum Deciduous Stocking*	Minimum Total Cutblock Stocking
Areas harvested March1, 1991 to April 30, 2000	50%	10%	80%
Areas harvested After May 1, 2000	50%	30%	80%

*Overlapping plots may be counted

3.2.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

Under the Performance Survey, and in addition to the above criteria, both coniferous seedlings and coniferous advance growth must meet the criteria of **Free-to-Grow** in order to be considered as a crop tree. There is no requirement for Free-to-Grow criteria for deciduous species. Within the Free-to-Grow definition, any broadleaved vegetation is

deemed to be a competitor tree/shrub (other than mature residual deciduous trees) based on the following rules:

For surveys conducted between 8-11 years after harvest:

1. Any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and
2. That is equal to or greater than 2/3 the crop tree height

For surveys conducted between 12-14 years after harvest;

1. Any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and
2. That is equal to or greater than the crop tree height, and
3. With a base diameter equal to or greater than 70% of the conifer crop tree root collar diameter diameter.

Conifer trees in the spruces species group that are without competing vegetation in three of four quadrants within the 1.78 m cylinder are considered to have met the Free-to-Grow criteria. Conifer trees with competitors within one or two of four quadrants of the cylinder and that meet specified performance criteria are considered to be provisionally FTG according to the details provided in the following table:

Species	Performance Indicators	Allowable area of cylinder with competitors
Spruces, firs	None*	Competitor trees/shrubs in one of four quadrants *
Spruces, firs	Last 2 year leader increment => 60 cm OR total height => 2.5m	Competitor trees/shrubs in two of four quadrants
Pines, larches	Height:diameter ratio < 0.55 OR total height =>3.5m	Competitor trees/shrubs in one of four quadrants

* These crop trees are considered FTG and not provisionally FTG. Performance indicators are not required for these crop trees to meet the FTG criteria.

Provisionally FTG plots may be used in the calculation of the required minimum stocking levels (Table 3.5) according to the following maximum countable proportions.

Total Provisional	Provisional Spruces	Provisional Pines
25%	25%	10%

Provisionally FTG plots in excess of the allowable limits shown in the above table are considered to be NSR.

3.2.3.1 Crop tree species

Table 3.6 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a coniferous-deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 3.6

Crop tree species including advance growth
for areas being reforested to a coniferous-deciduous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

3.2.3.2 Crop tree height

Table 3.7 details the minimum coniferous performance height requirements for a crop tree on areas being reforested to a coniferous-deciduous standard.

Table 3.7

Coniferous crop tree performance height requirements
for areas being reforested to a coniferous-deciduous standard.

Sub-region (North of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Central Mixedwood Dry Mixedwood Wet Mixedwood	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	150
		P to VP	F – H	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – E	75
		P to VP	F – H	60
	Sw	VR, R, W, MW, &I	A – E	100
		P to VP	F – H	80
Lower Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	150
		P to VP	G – J (F – H)	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	75
		P to VP	G – J (F – H)	60
	Sw	VR, R, W, MW, &I	A – F (A – E)	100
		P to VP	G – J (F – H)	80

Boreal Highlands	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	150
		P to VP	F – G	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – E	75
		P to VP	F – G	60
	Sw	VR, R, W, MW, &I	A – E	100
		P to VP	F – G	80
Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	125
		P to VP	G – J (F – H)	110
	Sb, Fa	VR, R, W, MW, &I	A – F (A – E)	65
		P to VP	G – J (F – H)	55
	Sw, Se	VR, R, W, MW, &I	A – F (A – E)	85
		P to VP	G – J (F – H)	70
Montane	Pl, Pf, Lt	VR, R, W, MW, &I	A – E (A – F)	105
		P to VP	F – G (G)	95
	Sb, Fa	VR, R, W, MW, &I	A – E (A – F)	55
		P to VP	F – G (G)	45
	Fd	VR, R, W, MW, &I	A – E (A – F)	35
	Sw, Se	VR, R, W, MW, &I	A – E (A – F)	70
		P to VP	F – G (G)	60

Subalpine	Pl, Pw, Lt, La	VR, R, W, MW, &I	A – D (A – F)	105
		P to VP	E – I (G – H)	95
	Sb, Fa	VR, R, W, MW, &I	A – D (A – F)	55
		P to VP	E – I (G – H)	45
	Sw, Se	VR, R, W, MW, &I	A – D (A – F)	70
		P to VP	E – I (G – H)	60

Sub-region (South of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Lower Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	100
		P to VP	G – J (F – H)	85
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	55
		P to VP	G – J (F – H)	45
	Sw	VR, R, W, MW, &I	A – F (A – E)	75
		P to VP	G – J (F – H)	65
Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	80
		P to VP	G – J (F – H)	70
	Sb, Fa	VR, R, W, MW, &I	A – F (A – E)	55
		P to VP	G – J (F – H)	40
	Sw, Se	VR, R, W, MW, &I	A – F (A – E)	70
		P to VP	G – J (F – H)	60
Montane	Pl, Pw, Pf, Lw	VR, R, W, MW, &I	A – E (A – F)	60
		P to VP	F – G (G)	55
	Sb, Fa	VR, R, W, MW, &I	A – E (A – F)	45
		P to VP	F – G (G)	35
	Sw, Se	VR, R, W, MW, &I	A – E (A – F)	65
		P to VP	F – G (G)	55
	Fd	VR, R, W, MW, &I	A – E (A – F)	35

Sub-region (South of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Subalpine	Pl, Pw, Pf, Lt, La, Lw	VR, R, W, MW, &I	A – D (A – F)	60
		P to VP	E – I (G – H)	55
	Sb, Fa	VR, R, W, MW, &I	A – D (A – F)	45
		P to VP	E – I (G – H)	35
	Sw, Se	VR, R, W, MW, &I	A – D (A – F)	65
		P to VP	E – I (G – H)	55
	Fd	VR, R, W, MW, &I	A –E (A – F)	35

Table 3.8 details the minimum deciduous performance height requirements for a deciduous crop tree on areas being reforested to a coniferous-deciduous standard.

Table 3.8

Deciduous crop tree performance height requirements for areas being reforested to a coniferous-deciduous standard

Natural Sub-region	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Central Mixedwood Dry Mixedwood Wet Mixedwood	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	200
		P to VP	F - H	150
Boreal Highlands	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	200
		P to VP	F - G	150
Lower Foothills	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	175
		P to VP	G – J (F – H)	125
Upper Foothills	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	150
		P to VP	G – J (F – H)	115

Natural Sub-region	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Montane	Aw, Pb, Bw	VR, R, W, MW, & I	A – E (A – F)	150
		P to VP	F – G (G)	115
Subalpine	Aw, Pb, Bw	VR, R, W, MW, & I	A – D (A – F)	150
		P to VP	E – I (G – H)	115

3.3 Deciduous-Coniferous Standard (DC)

3.3.1 Timing of Survey

The Performance Survey must be carried out no sooner than 8 years and no later than 14 years after harvesting is completed and must not be completed within 2 growing seasons after a stand tending treatment is completed.

It is possible to use one survey visit to collect the data required for both the Establishment Survey and Performance Surveys, providing the survey is done in year 8, so that the minimum and maximum timing parameters are met for both types of surveys and the 2 growing season treatment rule is observed.

3.3.2 Stocking

The basic sampling unit is a ten square metre, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one **crop tree** which meets the species, height and other characteristics in Tables 3.10, 3.11, and 3.12.

A cutblock being reforested to a deciduous-coniferous (DC) standard will be considered satisfactorily restocked (SR) when total cutblock stocking equals 80% or more of the sample plots. The stocked plots must be distributed evenly over the sample area and must meet the minimum proportions specified in Table 3.9.

In order to meet the minimum proportions of coniferous and deciduous outlined in Table 3.9, the use of "overlapping plots" is permitted. "Overlapping plots" are plots that may be counted twice in the calculation to meet the required minimum species proportions shown in Table 3.9, given that the plot contains both a coniferous and a deciduous crop tree. An overlapping plot is considered SR, but may only be counted once in the total cutblock stocking calculation.

Table 3.9

Cutblock	Minimum Conifer Stocking*	Minimum Deciduous Stocking*	Minimum Total Cutblock Stocking
Areas harvested March1, 1991 to April 30, 2000	30%	30%	80%
Areas harvested After May 1, 2000	30%	50%	80%

*Overlapping plots may be counted

3.3.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;
4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species.

Under the Performance Survey, and in addition to the above criteria, both coniferous seedlings and coniferous advance growth must meet the criteria of **Free-to-Grow** in order to be considered as a crop tree. There is no requirement for Free-to-Grow criteria for deciduous species. Within the Free-to-Grow definition, any broadleaved vegetation is

deemed to be a competitor tree/shrub (other than mature residual deciduous trees) based on the following rules:

For surveys conducted between 8-11 years after harvest:

1. Any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and
2. That is equal to or greater than 2/3 the crop tree height

For surveys conducted between 12-14 years after harvest;

1. Any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and
2. That is equal to or greater than the crop tree height, and,
3. With a base diameter equal to or greater than 70% of the conifer crop tree root collar diameter.

Conifer trees in the spruces species group that are without competing vegetation in three of four quadrants within the 1.78 m cylinder are considered to have met the Free-to-Grow criteria. Conifer trees with competitors within one or two of four quadrants of the cylinder and that meet specified performance criteria are considered to be provisionally FTG according to the details provided in the following table:

Species	**Performance Indicators**	**Allowable area of cylinder with competitors**
Spruces, firs	None*	Competitor trees/shrubs in one of four quadrants*
Spruces, firs	Last 2 year leader increment => 60 cm OR total height => 2.5m	Competitor trees/shrubs in two of four quadrants
Pines, larches	Height:diameter ratio < 0.55 OR total height =>3.5m	Competitor trees/shrubs in one of four quadrants

* These crop trees are considered FTG and not provisionally FTG. Performance indicators are not required for these crop trees to meet the FTG criteria.

Provisionally FTG plots may be used in the calculation of the required minimum stocking levels (Table 3.9) according to the following maximum countable proportions.

Total Provisional	Provisional Spruces	Provisional Pines
15%	15%	10%

Provisionally FTG plots in excess of the allowable limits shown in the above table are considered to be NSR.

3.3.3.1 Crop tree species

Table 3.10 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a deciduous-coniferous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 3.10

Crop tree species including advance growth

for areas being reforested to a deciduous-coniferous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

3.3.3.2 Crop tree height

Table 3.11 details the minimum coniferous performance height requirements for a crop tree on areas being reforested to a deciduous-coniferous standard.

Table 3.11

Coniferous crop tree performance height requirements for areas being reforested to a deciduous-coniferous standard.

Sub-region (North of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Central Mixedwood Dry Mixedwood Wet Mixedwood	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	150
		P to VP	F – H	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – E	75
		P to VP	F – H	60
	Sw	VR, R, W, MW, &I	A – E	100
		P to VP	F – H	80
Lower Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	150
		P to VP	G – J (F – H)	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	75
		P to VP	G – J (F – H)	60
	Sw	VR, R, W, MW, &I	A – F (A – E)	100
		P to VP	G – J (F – H)	80
Boreal Highlands	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	150
		P to VP	F – G	130
	Sb, Fa, Fb	VR, R, W, MW, &I	A – E	75
		P to VP	F – G	60
	Sw	VR, R, W, MW, &I	A – E	100
		P to VP	F – G	80

Sub-region (North of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	125
		P to VP	G – J (F – H)	110
	Sb, Fa	VR, R, W, MW, &I	A – F (A – E)	65
		P to VP	G – J (F – H)	55
	Sw, Se	VR, R, W, MW, &I	A – F (A – E)	85
		P to VP	G – J (F – H)	70
Montane	Pl, Pf, Lt	VR, R, W, MW, &I	A – E (A – F)	105
		P to VP	F – G (G)	95
	Sb, Fa	VR, R, W, MW, &I	A – E (A – F)	55
		P to VP	F – G (G)	45
	Fd	VR, R, W, MW, &I	A – E (A – F)	35
	Sw, Se	VR, R, W, MW, &I	A – E (A – F)	70
		P to VP	F – G (G)	60
Subalpine	Pl, Pw, Lt, La	VR, R, W, MW, &I	A – D (A – F)	105
		P to VP	E – I (G – H)	95
	Sb, Fa	VR, R, W, MW, &I	A – D (A – F)	55
		P to VP	E – I (G – H)	45
	Sw, Se	VR, R, W, MW, &I	A – D (A – F)	70
		P to VP	E – I (G – H)	60

Sub-region (South of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Lower Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	100
		P to VP	G – J (F – H)	85
	Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	55
		P to VP	G – J (F – H)	45
	Sw	VR, R, W, MW, &I	A – F (A – E)	75
		P to VP	G – J (F – H)	65
Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	80
		P to VP	G – J (F – H)	70
	Sb, Fa	VR, R, W, MW, &I	A – F (A – E)	55
		P to VP	G – J (F – H)	40
	Sw, Se	VR, R, W, MW, &I	A – F (A – E)	70
		P to VP	G – J (F – H)	60
Montane	Pl, Pf, Lt	VR, R, W, MW, &I	A – E (A – F)	60
		P to VP	F – G (G)	55
	Sb, Fa	VR, R, W, MW, &I	A – E (A – F)	45
		P to VP	F – G (G)	35
	Sw, Se	VR, R, W, MW, &I	A – E (A – F)	65
		P to VP	F – G (G)	55
	Fd	VR, R, W, MW, &I	A – E (A – F)	35

Sub-region (South of the North Saskatchewan River)	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Subalpine	Pl, Pw, Pf, Lt, La, Lw	VR, R, W, MW, &I	A – D (A – F)	60
		P to VP	E – I (G – H)	55
	Sb, Fa	VR, R, W, MW, &I	A – D (A – F)	45
		P to VP	E – I (G – H)	35
	Sw, Se	VR, R, W, MW, &I	A – D (A – F)	65
		P to VP	E – I (G – H)	55
	Fd	VR, R, W, MW, &I	A –F (A – F)	35

Table 3.12 details the minimum deciduous performance height requirements for a deciduous crop tree on areas being reforested to a deciduous-coniferous standard.

Table 3.12

Deciduous crop tree performance height requirements for areas being reforested to a deciduous-coniferous standard

Natural Sub-region	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)
Central Mixedwood Dry Mixedwood Wet Mixedwood	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	200
		P to VP	F - H	150
Boreal Highlands	Aw, Pb, Bw	VR, R, W, MW, & I	A – E	200
		P to VP	F - G	150
Lower Foothills	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	175
		P to VP	G – J (F – H)	125
Upper Foothills	Aw, Pb, Bw	VR, R, W, MW, & I	A – F (A – E)	150
		P to VP	G – J (F – H)	115

Montane	Aw, Pb, Bw	VR, R, W, MW, & I	A – E (A – F)	150
		P to VP	F – G (G)	115
Subalpine	Aw, Pb, Bw	VR, R, W, MW, & I	A – D (A – F)	150
		P to VP	E – I (G – H)	115

3.4 Deciduous Standard (D)

3.4.1 Timing of Survey

For areas satisfactorily restocked in the establishment survey there is no performance survey required to meet the deciduous performance standard. Conditionally restocked areas, however, are subject to a deciduous performance survey which must be carried out no sooner than 10 years and no later than 14 years after harvesting is completed.

3.4.2 Stocking and Average Height

The basic sampling unit is a ten square meter, circular plot 1.78 metres in radius. This sample plot is considered stocked if it contains at least one performing **crop tree** which meets the species, height and other limitations as defined below.

A cutblock that is to be reforested to a deciduous (D) standard will be considered satisfactorily restocked (SR) when:

(a) 80% or more of the sample plots are stocked with at least one performing crop tree and a minimum of 60% of plots are stocked with deciduous crop trees, and;

(b) the average height of deciduous crop tree for the area is greater than or equal to the average height of the deciduous trees by subregion and drainage class. (Table 3.14)

3.4.3 Crop Trees

A **crop tree** is a specific tree of acceptable species which has achieved the minimum height requirement, is alive, healthy and undamaged, and has grown on-site for a minimum of three years, or may be acceptable as **advance growth** as defined below:

1. The tree was established in advance of the harvest and meets the minimum height requirements, and;
2. The tree shows good health and vigour, is undamaged, and will probably be alive and merchantable when the rest of the crop trees are harvested, and;
3. The tree has a well-defined stem with not more than two stems originating at the base nor more than three multiple lateral shoots not originating at the base (this does not apply to those deciduous species that regenerate through coppice growth. Each healthy stem in coppice growth may be considered a separate crop tree), and;

4. The tree originated from seed, suckering or coppice but not from layering, and;
5. The crown covers two-thirds or more of the tree height and appears to be normal in form for the species. The crown cover requirement does not apply to deciduous trees.

Table 3.13 details the crop tree species which are acceptable, including advance growth, on areas being reforested to a deciduous standard. Species which do not occur naturally in a subregion will not be accepted unless approved by the Land and Forest Division.

Table 3.13

Crop tree species including advance growth
for areas being reforested to a deciduous standard.

Coniferous Species	Deciduous Species
White spruce	Trembling aspen
Englemann spruce	Balsam (Black) poplar
Black spruce	Hybrid poplar *
Lodgepole pine	White (Paper) birch
Jack pine	
Whitebark pine	
Limber pine	
Tamarack	
Western larch	
Alpine larch	
Siberian larch *	
Douglas-fir	
Balsam fir **	
Alpine fir **	

* non-native species are only acceptable for reforestation when a comprehensive strategy is detailed in an approved Detailed Forest Management Plan (DFMP).

** Balsam fir and Alpine fir may be considered acceptable species for specific cutblocks as per directive # 2001-01. A copy of this Directive can be found on the Alberta Sustainable Resource Development website:

www3.gov.ab.ca/srd/forests/fmd/directives/index.html

The amount of fir which is acceptable on a block by block basis is determined prior to survey.

3.4.4 Crop tree height

Table 3.14 provides the minimum heights for various species groups and sites as required to meet the deciduous performance standard.

Table 3.14

Crop tree height and average height requirements for areas being reforested to a deciduous standard.

Natural Sub-region	Species	Drainage Class	Ecosite	Minimum crop tree height (cm)	Minimum average height of acceptable deciduous trees*
Central Mixedwood Dry Mixedwood Wet Mixedwood	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	160	n/a
		P to VP	F – H	160	n/a
	Sw, Sb, Fb, Fa	VR, R, W, MW, &I	A – E	80	n/a
		P to VP	F – H	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – E	200	400
		P to VP	F – H	200	300

Lower Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	160	n/a
		P to VP	G – J (F – H)	160	n/a
	Sw, Sb, Fa, Fb	VR, R, W, MW, &I	A – F (A – E)	80	n/a
		P to VP	G – J (F – H)	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – F (A – E)	150	250
		P to VP	G – J (F – H)	150	250
Boreal Highlands	Pl, Pj, Lt	VR, R, W, MW, &I	A – E	160	n/a
		P to VP	F – G	160	n/a
	Sw, Sb, Fa, Fb	VR, R, W, MW, &I	A – E	80	n/a
		P to VP	F – G	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – E	200	400
		P to VP	F – G	200	300
Upper Foothills	Pl, Lt	VR, R, W, MW, &I	A – F (A – E)	160	n/a
		P to VP	G – J (F – H)	160	n/a
	Sw, Sb, Fa	VR, R, W, MW, &I	A – F (A – E)	80	n/a
		P to VP	G – J (F – H)	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – F (A – E)	150	250
		P to VP	G – J (F – H)	150	190

Montane	Pl, Pf, Lt	VR, R, W, MW, &I	A – E (A – F)	160	n/a
		P to VP	F – G (G)	160	n/a
	Sw, Sb, Fa, Fd	VR, R, W, MW, &I	A – E (A – F)	80	n/a
		P to VP	F – G (G)	80	n/a
	Aw, Pb, Bw	VR, R, W, MW, &I	A – E (A – F)	150	250
		P to VP	F – G (G)	150	190

* **The average height of acceptable deciduous trees** is the arithmetic mean of the tallest deciduous tree from each plot in the cutblock stocked to deciduous species, excluding advance growth and those plots contributing to the declared conifer stocking percentage.

4.0 Wet, Low Density Standard

Sites with poor or very poor drainage combined with low original stand density may, if approved by the Land and Forest Division prior to harvest, be reforested to a modified stocking standard (**Wet, Low density Standard**). Approved Wet Low Density Standard cutblocks will be considered satisfactorily restocked when 50% or more of the sample plots are stocked with at least one coniferous crop tree (crop tree as defined in previous sections of this manual). The stocked plots must be distributed evenly over the sample area.

A cutblock is a **candidate** for the Wet, Low Density Standard when:

(a) The original stand cover type indicated an A or B density and an ecosite assessment indicates poor drainage (P-VP) and poor nutrient level, **or**;
(b) The original stand cover type indicated an A or B density and an ecosite assessment indicates very poor drainage (VP).

Height requirements are the same as those described for C, CD, and DC standards. There is no Wet, Low Density Standard for deciduous (D) strata cutblocks.

5.0 Field Survey Procedures

In order to ensure that regeneration surveys are completed and reported consistently across Alberta, procedures and reporting forms are standardized. Regeneration survey information and data is to be recorded on the Regeneration Survey Information Sheet, Regeneration Tally Sheet, and the Regeneration Survey Field Map Sheet and Regeneration Survey Summary sheet. The templates for these forms are available from the Alberta Sustainable Resource Development website: **www3.gov.ab.ca/srd/forests/fmd/manuals/index.html.**

In this chapter, the standardized methods for conducting surveys, completing the tally, information and summary sheets and drafting the field map, are described. **Unless otherwise indicated, all information contained on the tally sheets is mandatory to record.**

5.1 Cutblock Survey Information

The Regeneration Survey Information Sheet is the first page in the Regeneration Survey Tally Sheet package. The Regeneration Survey Information Sheet identifies the cutblock and provides data needed to determine the standards on a per plot and cutblock basis. The following descriptions are provided to help explain what is required for each heading on the form:

5.1.1 Survey Details	
Survey Date:	Day, month, and year of survey completion
Surveyed by:	Name of certified surveyor and other surveyors. Primary surveyor first, helpers second.
Certification Number:	Number assigned by Alberta Sustainable Resource Development to the primary surveyor who has met the qualifications for certification.
5.1.2 Cutblock Description and Survey Type	
Opening Number:	The official cutblock number used by Alberta Sustainable Resource Development for keeping. This number is assigned to the cutblock according to the legal location of the centre of the cutblock. The assigning of this number legitimizes the cutblock opening in the Provincial records and is mandatory.
Disposition:	The FMA, license or permit number under which the cutblock was harvested.
Holder/ Operator:	The company responsible for reforestation.
Skid Clearance Date:	The year in which skid clearance was given to the cutblock. This date is technically when the reforestation clock starts.
Company Block Number:	A unique number used by the timber operator.
Field Number:	Cutblock identifier common to company or LFD district assignment. Not as universal as the Opening Number.
Forest Area:	The LFD administrative unit.

Subregion:	Alberta's forested areas are classified into geographical areas, which exhibit similar natural forest vegetation. Enter the short version of the Natural Subregion. DM Dry Mixedwood WM Wetland Mixedwood BH Boreal Highland LF Lower Foothills UF Upper Foothills SA Subalpine MO Montane
Ecosite:	Within each subregion, cutblocks or portions of cutblocks can be classified into plant community types. This ecosite categorization will have been determined in the pre-harvest survey. Enter the ecosite code as in "E1.1". Choosing to no fill in this data category may mean that a desired minimum standard may not be applied.
Drainage Class:	Drainage assessments provide a standard method for assessing soil moisture conditions. Enter the code of the drainage class for the cutblock or the portion of the cutblock. Choosing to not fill in this data category may mean that a desired minimum standard may not be applied. **VR** Very rapid **R** Rapid **W** Well **MW** Moderately well **I** Imperfectly **P** Poorly **VP** Very Poorly
General Location:	Because Natural subregions may extend great distances north and south, the regeneration survey makes a separation using the North Saskatchewan River as the border. Circle either North or South in reference to the North Saskatchewan River.
Survey Type:	Check the appropriate box as to whether the survey is an Establishment (year 4-8 or 3-5) or a Performance (year 8-14 or 10-14). Wet, Low Density Standard is also available to be selected and is to be determined in a preharvest period.
Fir Acceptable:	Check the box in this category if fir has been deemed an acceptable species by virtue of Policy Directive 2001-01. This must be determined in a preharvest period.
Classify To:	Check the appropriate box as to whether the 2000 standard is being applied or the 1991 standard. Please note that Policy Directive 2001-02 outlines how the designation to the 1991 standard is to be applied.

Strata Standard:	This identifies the species mix which reforestation efforts are expected to produce, and hence the survey standard to be used. Circle the appropriate strata standard for the cutblock as it was originally classified. The codes used are defined as follows: **C** Coniferous **CD** Coniferous/Deciduous mixedwood **DC** Deciduous/Coniferous mixedwood **D** Deciduous
Survey Grid:	The survey grid is the selected line and plot spacing in Section 5.1.4. ▪ Line spacing is the distance between plots along the line measured in metres to the nearest 0.1 metres. ▪ Plot spacing in the distance between plots along the line measured in metres tot he nearest 0.1 metres.
Cutblock Area:	Area in hectares, commonly determined after harvesting using aerial photos, GPS unit or traverse of the perimeter.

5.1.3 Determining the Number of Sample Plots Required

The number of plots required within the various sizes of cutblocks is shown in Table 5.1.

Table 5.1

Sampling requirements for Establishment and Performance surveys.

Block Size (Ha)	Number of Sample Plots Required
0.1 – 1.9	Minimum of 12.4 plots/ha
2.0 – 4.0	Establish minimum of 41 plots/block or as many as needed to cover block. If stocking is in 73% - 79% range, intensify to 54 plots.
4.1 – 24.0	Establish minimum of 64 plots/block or as many as needed to cover block. If stocking is in 73% - 79% range, intensify to 84 plots.
> 24.0*	2.77 plots/ha

*To determine the number of sample plots needed for cutblocks which are greater than 24 ha, simply multiply the gross block area by 2.77. Round the decimal up to the nearest whole number.

5.1.4 Calculating the Survey Grid (line and plot spacing)

Square Spacing

The survey standard is a square grid pattern where the distance between lines equals the distance between plots. Once the total number of plots and the area of the block are known, the survey grid (plot and line spacing) can be calculated.

$$\text{Plot spacing} = \sqrt{\frac{\text{Cutblock Area (ha)} \times 10{,}000\ (m^2/ha)}{\text{Required \# of plots}}}$$

Example:

For surveys on a 12.1 ha block, calculate a square survey grid.

1. A 12.1 ha block requires that 64 plots be established initially (Table 5.1)
2. Calculate the plot spacing:

$$\text{Plot Spacing} = \sqrt{\frac{\text{Cutblock Area (ha)} \times 10{,}000\ (m^2/ha)}{\text{Required \# of plots}}}$$

$$= \sqrt{\frac{12.1 \times 10{,}000}{64}}$$

$$= \sqrt{1890.625}$$

$$= 43.48$$

3. Round off to the nearest 0.1m:

line spacing = 43.5 m plot spacing = 43.5 m

NOTE: Appendix 4 contains calculated square spacing distances for various cutblock sizes.

Rectangular spacing

Line spacing may differ from plot spacing provided the line spacing does not exceed twice the plot spacing. For cutblocks 24 ha and larger, a 60 m by 60m square grid must be used.

In order to calculate rectangular spacing, one usually selects the desired line spacing, then calculates the plot spacing needed to achieve the correct number of plots.

Example:

For surveys on a 3.9 ha block; calculate a rectangular survey grid, assuming a line spacing of 35 m.

1. A 3.9 ha block requires that 41 plots be established initially (Table 5.1)

2. Plot spacing x line spacing $= \sqrt{\frac{\text{Cutblock Area (ha)} \times 10{,}000\ (m^2/ha)}{\text{Required \# plots}}}$

   Plot spacing x 35m $= \sqrt{\frac{3.9\ ha \times 10{,}000\ m^2/ha}{41\ plots}}$

   Plot spacing $= \sqrt{\frac{951.22m^2}{35m}}$

   Plot spacing $=$ 27.1777m

3. Round off to the nearest 0.1 m :
   line spacing = 35.0 m plot spacing = 27.2 m

5.2 Field Layout

5.2.1 Control Lines and Survey Lines

For each area to be surveyed, control line(s) should be established for control of line plot and location as follows:

(a) Establish one control line that is parallel to the long axis of the cutblock. Additional parallel control lines are required every 400 metres where cutblock width exceeds 400m.

(b) The control line is usually placed in line with the grid so that points along the control line are used as plot centres. The control line(s) should be referenced to the cutblock boundary in order to be able to map the sample plot locations accurately. Starting from the cutblock edge, the first line is located at one-half the interline distance, and each additional survey line is marked at the exact distance line

(c) Survey line intervals on the control line are to be double flagged with two different colours and the line and plot number clearly written on the flagging.

(d) All survey and control lines are to be compassed and measured using a tape or string measuring device. All measured distances must be based on horizontal or surface projections.

5.2.2 Plot Layout

a. Beginning at the control line, the individual plots are located by compass and distance measurement.
b. The size of the sample plot shall be 1/1000 ha or $10m^2$.
c. The shape of the sample plot shall be circular and have a radius of 1.78 m; the centre of the circle and the plot centre shall be a common point.
d. Every plot centre is to be clearly marked in the field. Mark plot centres with a stake firmly planted in the ground at the plot centre. Write the plot number and line number on a piece of flagging with a black, waterproof marker pen and then attach the flagging to the stick. Do not use grass herbs or shrubs to indicate plot centres.
e. Crop trees (both coniferous and deciduous) must be marked with flagging in every plot to facilitate field checking.

5.2.3 Plots to Delete

In order for an area to be deleted from a regeneration survey, it must be under a disposition or classed as a "natural deletion". When it is known at the start of the survey that an area must be deleted from the cutblock due to an active disposition or natural deletion, the grid is to be calculated based on the reduced cutblock area. As the grid is being surveyed in, any plot landing on the deletion should be deleted. If the area of the deletion is correct, the proper number of plots to fill the opening should be obtained without moving any plots.

Examples of dispositions to delete from the cutblock area are:

- MLL Miscellaneous lease (campsite, sand and gravel, etc.)
- PLA Pipeline Agreement
- LOC Licence of Occupation Road
- Well site
- Archeological and historic sites
- Permanent sample plots or other research areas (in most cases)

Natural deletions to delete from the cutblock area are:

- Riparian areas and uncut buffers (no stumps encountered; 0.04 ha or larger)
- Uncut patches within the cutblock (no stumps encountered; any identifiable areas)

Note that cutlines are not listed above as a disposition that is deleted from a cutblock area. Therefore, in cutblocks harvested after May 1, 2000 and subsequently surveyed, plots falling on cutlines will not be deleted or moved but are to be tallied as they are encountered. In cutblocks harvested before May 1, 2000, plots may be moved off of cutlines, as described in section 5.2.4. Cutlines were not usually planted in those cutblocks harvested prior to May 1, 2000.

5.2.4 Plots to Move

While establishing plots, the surveyor may encounter a new disposition or natural deletion which will not be reforested and which had not been subtracted from the cutblock area at the time the grid was calculated. As a result, the grid may be set at a wider spacing than it should be in order to obtain the required number of plots. Therefore, when the disposition or unexpected deletion is encountered, the plot should be moved half the plot distance toward the next plot to help obtain the required number without adding plots later (see Section 5.2.5). If the plot still lands on the disposition, continue to move at one half the plot distance intervals until a plot can be established. The plot following a moved plot remains at its normal grid location.

5.2.5 Adding Plots

The minimum number of plots must be established (see Table 5.1). If additional plots are required to make up this minimum number, they should be spaced a follows:

a. Halfway between every third survey line (i.e., halfway between and parallel to the third and fourth survey lines, sixth and seventh lines, etc.)
b. Plot spacing should be the same on the additional lines as on the original lines to facilitate delineation of SR/NSR areas.
c. If use of every third line is not enough to add all the plots needed, proceed to add lines between other survey lines until the desired number of plots is reached. Lines must be marked on the control line and numbered with a sequential numeral (no letters).

5.2.6 Defining Ecosite and Site Drainage Classifications

All assessments of drainage class or ecosite classification will be conducted using site evaluation methods acceptable to the Forest Area Manager. The classification will be conducted on a cutblock by cutblock basis by personnel suitably trained and experienced. If the forest operator wishes to indicate discrete and mappable areas of the cutblock where drainage class differences occur, he must submit site evaluation information along with the regeneration surveys.

Proper ecosite classification requires evaluation of the undisturbed plant community types and therefore must be conducted prior to harvest. In the case of ecosite classification where the equivalent to P-VP drainage class is expected, the Forest Area Manager reserves the right to refuse the classification where a soil drainage assessment does not confirm the assumed moisture limitations for the ecosite.

Applicability

For D strata standard cutblocks cut after May 1, 1998, and for C, CD, and DC cutblocks cut after May 1, 2000, drainage and ecosite assessments conducted after harvest will not be accepted as just cause for modification to the classification (as defined by the VR to I drainage class by Natural Subregion). For D cutblocks with reforestation zero year commencing after March 1, 1991 but before May1, 1998, and for C, CD, and DC blocks with skid clearance after March 1, 1991 but before May1, 2000, drainage class assessments contributing to the determination of cutblock status may be conducted up to the time of establishment survey.

Stratification by ecosite or drainage class

Where cutblock areas are to be separated into discrete areas of differing drainage classes or ecosite classes, it is expected that these areas will be delineated and treated as separate cutblocks. For cutblocks with areas of differing drainage classes, where it is not desirable to treat these as separate cutblocks, the percentage of area for each drainage or ecosite class may be estimated.

For D cutblocks containing small, scattered areas of differing drainage or ecosite, the new cutblock minimum average height and minimum trees/plot requirements are calculated based on the respective percentages for each ecosite or drainage class.

For the C, CD, and DC strata standards, ecosite and drainage stratification will not be allowed unless the areas are mappable and are greater than 0.04 ha in size. The status for plots within P-VP drainage areas of less than 0.04 ha is assessed according to the standards for VR-I drainage classes.

5.3 Recording Plot Data on Tally Sheets

Regeneration survey data shall be recorded for each plot on the Regeneration Survey Tally Sheet. The following briefly describes the standards for plot measurements and completion of the appropriate blanks on the tally sheet. Use of tally sheets other than the standard forms must be approved by the Forest Area Manager before surveying begins.

5.3.1 Line and Plot Numbers

Each plot is identified by a numerical plot and line number. For lines added after the initial grid is applied, the line should be given the next number in the sequence, not a letter.

5.3.2 Species

Enter the species code of those seedlings or trees chosen as suitable representatives of their species on that plot. A "suitable species representative" shares the same definition as that used for a "Crop Tree". The "Crop Tree" definition appears in various locations within the text of the strata standard, in earlier sections of this manual. Choose only one representative per species to record. It is *mandatory* to record a dominant tree greater than 30 cm for each species represented on a plot. You have the *option* of recording tree species that are under 30 cm. These seedlings would subsequently be labelled "undersized".

A situation that may occur is a species representative is over 30 cm and healthy but has not achieved the minimum height standard to pass the plot. This seedling is still required to be recorded but could not be used as a crop tree to pass the plot.

In this category, fir does not have to pass the criteria for an acceptable crop tree (for the purposes of passing the standard) in order to be considered a "species representative". If fir is present on the plot and is healthy and greater then 30 cm, it should be recorded as a species representative along with the rest.
Tree Species Codes are as follows:

White spruce **Sw**	Englemann spruce **Se**	Black spruce **Sb**
Lodgepole pine **Pl**	Jack pine **Pj**	Whitebark pine **Pw**
Limber pine **Pf**	Tamarack **Lt**	Alpine larch **La**
Western larch **Lw**	Siberian larch **Ls**	Balsam fir **Fb**
Douglas fir **Fd**	Alpine fir **Fa**	Trembling aspen **Aw**
Balsam poplar **Pb**	White birch **Bw**	Shrub competition **Sh**

The above list can also be found on the Regeneration Survey Summary sheet for reference during the survey.

It is not always a requirement to record the presence of shrubs on the plot unless these species are clearly competition to a crop tree. No specific species need be recorded in this instance and the code given above is satisfactory.

The presence of a "Hybrid Poplar" code and a "Siberian Larch" code does not serve as approval of the use of these species in reforestation strategies. Approval for the use of these species in reforestation is still required from the genetics section of Forest Management Branch of the Land and Forest Division.

5.3.3 Type

Record the appropriate code for each species representative recorded in the "Species" column. The codes are defined below:

SDL – seedling (regenerated growth, planted or natural, not advance growth)
ADV – advance growth
SC – shrub competition. To be used as a code when doing Performance Surveys.
TC – tree competition. To be used as a code when doing Performance Surveys.

5.3.3.1 Competitor trees/shrubs (Performance Survey):

A competitor is a broadleaved tree or shrub that is taller than two-thirds the height of the crop tree (for surveys done between 8-11 years) or equal to the height of the crop tree and with a base diameter equal to or greater than 70% of the crop tree RCD (for surveys completed between 12-14 years). The competitor may be located outside the plot area. If, on a CD or DC cutblock, a tree/shrub is found only in one quadrant of the crop tree cylinder (leaving 270 degrees surrounding the crop tree free of competitors) it is not considered as a competitor for spruce, larch, fir or Douglas fir tree, but is a competitor for pine trees. Mature residual deciduous trees and coniferous trees are not evaluated as competitor trees. Alder, willow, dogwood and other woody shrubs are considered competitor shrub species. The competitor tree or shrub chosen must be flagged for the purpose of checking.

Record the competitor species as either TC (tree competition) or SC (shrub competition). Recording a tree as a competitor implies that the cylinder rule has **not** been met. The competitor tree (TC) may be one of the deciduous species representatives chosen for the plot.

The competitor tree (TC) must also be included as part of the density count if it is inside the plot.

5.3.4 Height

Measure and record the height of each of the species representatives on the plot to the nearest centimetre (cm). The height of the seedling/tree is measured from the base of the seedling/tree, at the average ground level, to the tallest reaching point of the live matter of the seedling/tree (see Figure 1). Seedlings are not to be stretched for this measurement.

In advance growth trees, measure the height to the nearest centimetre for trees less than 100 cm, to the nearest 10 centimetres for trees greater than 100 cm but less than 300cm, and if greater than 300 cm, estimate to the nearest 100 cm.

The height measurement assumes that the species representative is standing in a relatively vertical position. Seedlings or trees that lean greater than 30 degrees should not be chosen as species representatives or crop trees as the future form of a seedling or tree in this condition is suspect.

Height measurements on species representatives that are on a significant slope should be taken as described above but at the side of the tree, not on the uphill or downhill side (see Figure 2).

5.3.5 Age

Measure and record the age of each of the species representatives on each plot. Ages are a count of the number of branch whorls on coniferous trees and the number of bark scars on deciduous trees. Age estimates are to be made as accurately as possible. In advance growth, estimate as accurately as possible. To field-age a seedling, count the whorls, or breaks in the consistency of the bark, backwards from the present season's growth (terminal shoot), down to the root collar node. Add one year (season of germination to cotyledon) and record the age.

In relation to the requirement that a crop tree or species representative tree must have grown on site for a minimum of three years, one can count this period with planted seedlings as follows:

- If the seedling was planted prior to June 21, the growing season is the year the seedling was planted may be counted as one year if the regeneration survey is completed after August 1 or the second calendar year after the year of planting.

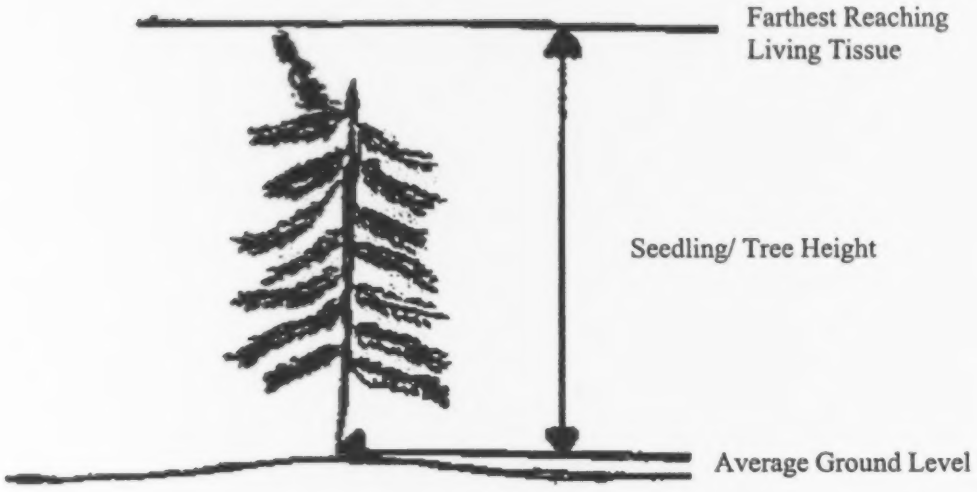


Figure 1: Measurement of Seedling / Tree Height on Flat Ground

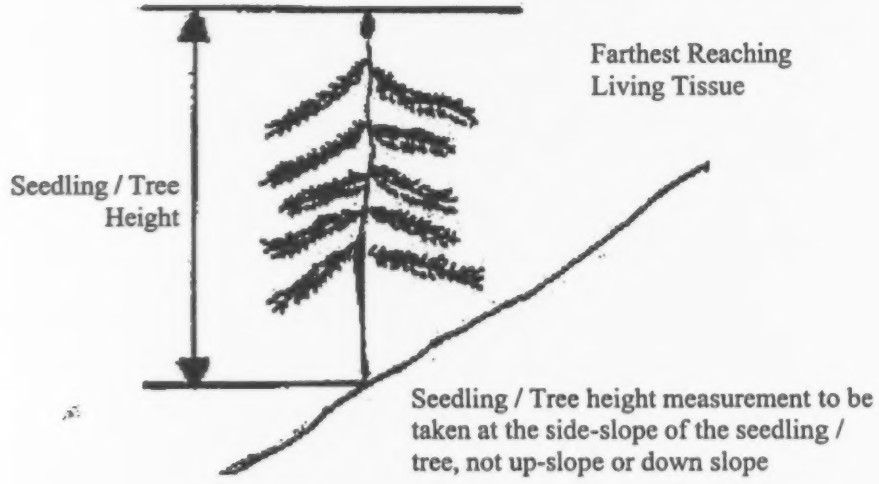
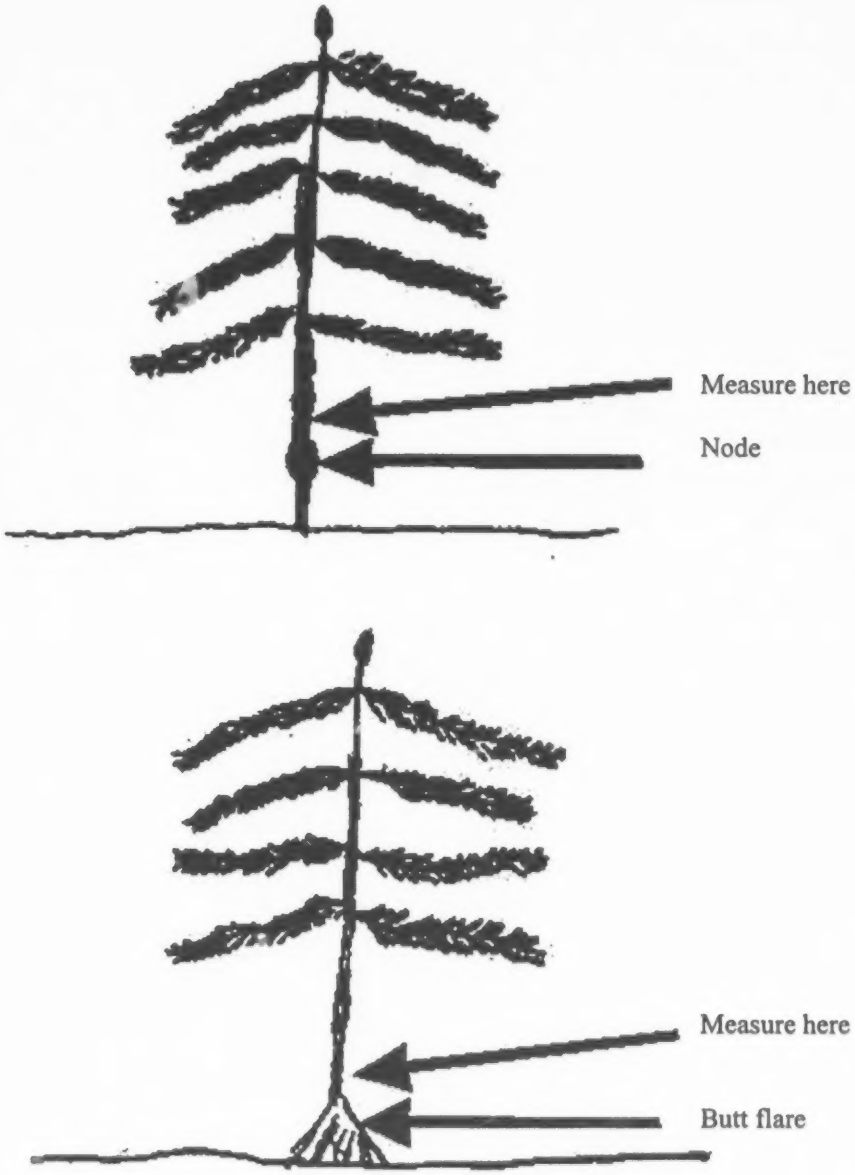

Farthest Reaching
Living Tissue
Seedling / Tree
Height
Seedling / Tree height measurement to be
taken at the side-slope of the seedling /
tree, not up-slope or down slope

Figure 2: Measurement of Seedling / Tree Height on Sloped Ground



Note: Butt flare should not be confused with an exposed root mass in a seedling. A partially exposed root mass may occur as the result of frost heave or poor planting. If this situation is encountered, the seedling should **not** be chosen as a crop tree as its future stability is suspect.

Figure 3: Measurement of Root Collar Diameter

5.3.6 RCD (Root Collar Diameter)

Root collar diameter is a required measurement only for the conifer crop tree at the Performance Survey.

Measuring RCD involves using a caliper to record the diameter of the seedling to the nearest millimetre. Position the caliper at the base of the seedling, immediately above the root collar node and record the measurement. If the seedling or tree being measured for RCD exhibits significant butt swell at the base, move the measurement for RCD up to the point where the butt swell taper disappears and normal bole is encountered (see Figure 3). For the purposes of checking, flag the seedling on which the RCD was measured.

5.3.7 Selected Crop Tree

One tree from each species type (coniferous or deciduous) will be used to pass the plot to the specific standard intended. Record the seedling intended as the crop tree in this column by placing the letter "S" in the appropriate box on the same line as the species chosen.

In the case of the CD or DC standard, it would be expected that two tree species would be designated as crop trees, one coniferous, the other deciduous. If re-designating the original survey to a different strata standard, ensure that all crop trees are properly labelled on the tally sheet. For the purposes of checking, all crop tree species chosen would be marked with ribbon at each plot.

5.3.8 FTG (Free-to-Grow)

Record whether the selected coniferous crop tree is free-to-grow to the "allowable cylinder rule" using the designation "F" or record if it is a provisionally Free-to-Grow plot by using the designation "PF" in the box on the same line as the selected crop tree.

Note that if the plan is to eventually swap a C cutblock for a CD or DC cutblock, one may wish to record whether the non-pine conifer is, in fact, FTG to the "spruces" rule. This choice is optional, but would serve to highlight the possibilities for the future in relation to other possible strata standards that could successfully be applied to the cutblock.

5.3.9 Drainage Class

Record the drainage class, as established in a pre-harvest assessment. The drainage class codes are as follows:

VR- very rapid **R**- rapid **W**- well **MW**-moderately well
I-imperfectly **P** – poor **VP**- very poor

If the drainage class for the whole cutblock remains as one class, this could be recorded once at the first plot and reiterated on the Regeneration Survey Information Sheet. If various drainage classes are to be applied to different plots in a cutblock, these changing designations would be recorded in this column on the tally sheet.

5.3.10 Capped Acceptable Deciduous Density

This applies to the Deciduous Standard only and is the number of deciduous crop trees on the plot, to a "capped" total of ten, that would be recorded, in partial fulfillment of the Deciduous Standard.

Enter a count of the number of deciduous crop trees that meet the minimum height requirements for the D strata standard and survey type. Record "10" if there are ten or more deciduous crop trees on the plot.

5.3.11 Density

In both the Establishment and Performance surveys, and for all strata standards, density data by species is to be collected on all plots. Enter the count of all seedlings/trees within that species on the same line as that species that was recorded originally on the left side of the tally sheet. Any crop tree or competition tree selected must also be included in the density count.

The category "30+ cm" is a mandatory data field and must be completed. The category "L.L. 29.9" is available to record those densities of trees below the mandatory 30 cm height limit. This category is *optional* and is available as a means of capturing populations that could contribute to the stand yield later in the rotation. The acronym "L.L." refers to "lower limit" and is established by the surveyor or silviculture planner. In this category, one would not have to record densities below the established lower limit.

The tally sheet contains approximately four blank columns on the right hand side. These columns are available to the user to record other types of data that they feel relevant to collect while doing the survey. Any data recorded in these blank columns do not form

any part of the requirements of the regeneration survey and are **not** considered mandatory by LFD.

5.3.12 Survey Results

This is the last section that appears on the Regeneration Survey Information Sheet, which serves as the cover sheet to the regeneration survey data sheet package. The data recorded on the tally sheet is rolled-up into summary categories within this section. These categories are described as follows:

1. **Total Plots:** Record the total number of plots used to complete the survey, including those plots added to fill the cutblock and those plots added as the result of the stocking percentage falling within the 73-79 % range.

2. **Cutblock Stocking Percentage:**
   There are three sub categories here: Total, %Deciduous, %Coniferous. Record the data in the appropriate spot.

3. **Average Deciduous Crop Tree Height:**
   Record this data if doing a deciduous survey. Take each of the deciduous crop tree heights per plot, add these up and divide by the number of crop trees used.

4. **Average Acceptable Deciduous Trees per Plot:**
   Record this data if doing a deciduous survey. Add the per-plot numbers of acceptable deciduous (capped at 10, record 10 if actual number is greater than 10) and divide by the total number of plots, include those plots with *no* acceptable deciduous trees in them as a part of this calculation.

5. **Lower Limit Density (L.L.):**
   If the choice is to record density data on that population of a species on a plot below the mandatory 30 cm height, then record the lower limit chosen here.

6. **Cutblock Status:**
   Circle the category the cutblock falls into. The codes are explained as follows:
   CRS – conditional status applied to results of establishment survey in deciduous strata standard.
   SR – satisfactorily restocked. Applies to those cutblocks that pass their strata standard.

NSR – not satisfactorily restocked. Applies to those cutblocks that fail their strata standard, or, regardless of achieving greater than 80% stocking, possess a 4 ha contiguous patch of NSR area.
FTG – a subcategory of SR applied indicating a pass of the strata standard in the Performance Survey. Circle this category in conjunction with the application of the SR status.
NFTG – a subcategory of NSR indicating a failure to meet the strata standard in the Performance Survey. Circle this category in conjunction with the application of the NSR status.

7. **NSR Area (ha.):**

   The area of the cutblock that is NSR. This may indicate a contiguous area greater than 4 ha or the entire cutblock.

8. **Roads and Landings Area:**

   Record the cumulative area that was under roads and landings. Then, provide a percentage estimate of the amount of area under roads and landings compared to the total cutblock area.

9. **Survey Passes:**

   This is an optional recording mechanism identifying those strata standards that the data allows to pass. One or more of these categories may be circled here and used for future reference by both industry and government.

5.4 On-site Stocking Check

Before the regeneration surveyor leaves the cutblock, a check of the survey's statistical accuracy must be made. The details of the statistical accuracy standards are provided in Appendix 2, however the surveyor simply needs to confirm that, based on the calculated stocking percentage, a sufficient number of valid sample plots have been established:

For cutblocks 2.0 to 4.0 ha in size, if stocking is in 73 – 79% range, 54 plots are required rather than the 41 that would be established initially.

For cutblocks 4.1 to 24.0 ha in size, if stocking is in 73- 79% range, 84 plots are required rather than the 64 that would be established initially.

5.4.1 Recalculating the Regeneration Survey Area

The first step in ensuring there are enough plots is to confirm that the cutblock area is correct. The cutblock area may not always account for deletions of non-productive and non-forested areas within the perimeter. Use of a square survey grid with known distances between plots and lines permits an easy calculation of the cutblock area. The principle is that each plot location represents an area (in square metres) equal to the line spacing multiplied by the plot spacing. To calculate the regeneration survey area simply multiply the area represented by one plot by the number of plots located in the grid. Divide by 10,000 to convert from square metres to hectares.

You may choose to record the calculated Regen Survey Area in the Survey Results box on the tally sheet. If not, the GPS area would be used.

$$\text{Regen survey area} = \frac{\text{line spacing x plot spacing x number of grid plots}}{10{,}000}$$

A **grid plot** is a non-deleted plot located on the predetermined plot and line spacing. Do not include plots that have been moved one half the plot distance, unless the reason for the move was a temporary deletion. Do not include plots, which have been deleted, or ones which have been added to lines not on the original line spacing (i.e. between lines).

5.4.2 Preliminary Stocking Percent

In order to determine if the stocking falls in the 73 – 79% range, a preliminary stocking percent is needed. Using the Stocking Summary table on the back of the Map Sheet, a preliminary stocking percent is calculated as follows:

Establishment survey stocking

1. For each species group, count the number of **satisfactorily restocked plots (SR)**; multiply by 100 and then divide by the total number of **valid** plots established so far to get a percent for each species group. All plots which have not been deleted are considered valid.
2. Add the percent for each of the species group to arrive at the preliminary stocking percent to the nearest 0.1%. Include the percent for plots stocked with both established conifer and established deciduous in the total cutblock stocking percent, but do not count any plot more than once.

Performance survey stocking

1. For each species group, count the number of **Free-to-Grow plots (FTG - including all allowable provisionally FTG plots) and deciduous (SR) plots**; multiply by 100 and then divide by the total number of **valid** plots established so far to get a percent for each species group. All plots which have not been deleted are considered valid.
2. Add the percent for each of the species group to arrive at the preliminary stocking percent to the nearest 0.1%. Include the percent of plots stocked with both FTG conifer and performing deciduous in the total cutblock stocking percent.

5.4.3 Adding More Plots and Recalculating Stocking

Using the preliminary stocking percent and the recalculated area (Regen Survey Area), refer to the Table 5.1 to determine the number of plots required. If for any reason more plots are need to be established, follow the rules for adding plots as presented in Section 5.2.5.

5.4.4 Damage, Site Conditions and Treatments Recommended

On the Regeneration Survey Summary sheet (the back of the map sheet) space is provided to record cutblock summary information specific to site conditions. Recording this data is optional, but may be very important for determining why a particular cutblock may have failed the survey. It will also help to determine what remedial action (further tending, cleaning, etc.) is needed to meet the management objectives. Keep track of any physical damage, insect or disease damage that you may observe on the crop trees or other trees in the plot and then report the extent of this damage on a cutblock basis using the table on the Regeneration Survey Summary sheet, (the back of the map sheet).

5.5 Field Map Completion

Field maps should be drawn on the standard Regeneration Survey Field Map Sheet as the surveyor progresses through the cutblock. This will help the surveyor map certain features of the cutblock and the status of the plots surveyed. All maps submitted are to show the following information for each cutblock surveyed:

a. Disposition and opening number.
b. Cutblock boundaries.
c. Total cutblock area. Use survey grid to check on block area. Make corrections where necessary.
d. North arrow.
e. Location of control line(s) and tie point(s) for same.
f. Location of survey lines and plots.
g. Plot numbers and line numbers.
h. The location and size of permanent deletions.
i. Symbols for stocking status and species grouping for each plot (see symbols below)
j. Scale of the map

k. Delineation of NSR areas (See Section 6.1.1 and example at end of this section)

All Surveys

- not cut or deleted plot

- undersized seedlings **(NSR)**

- non-stocked **(NSR)**

Establishment Survey

- stocked with coniferous crop tree **(SR)**

-stocked with deciduous crop tree **(SR)**

- stocked with conditional coniferous (deciduous survey only, 20% max.) **(SR)**

- stocked with **both** coniferous and deciduous crop trees **(SR)**

Performance Surveys

- stocked with coniferous crop tree, **not** Free-to-Grow **(NSR)**

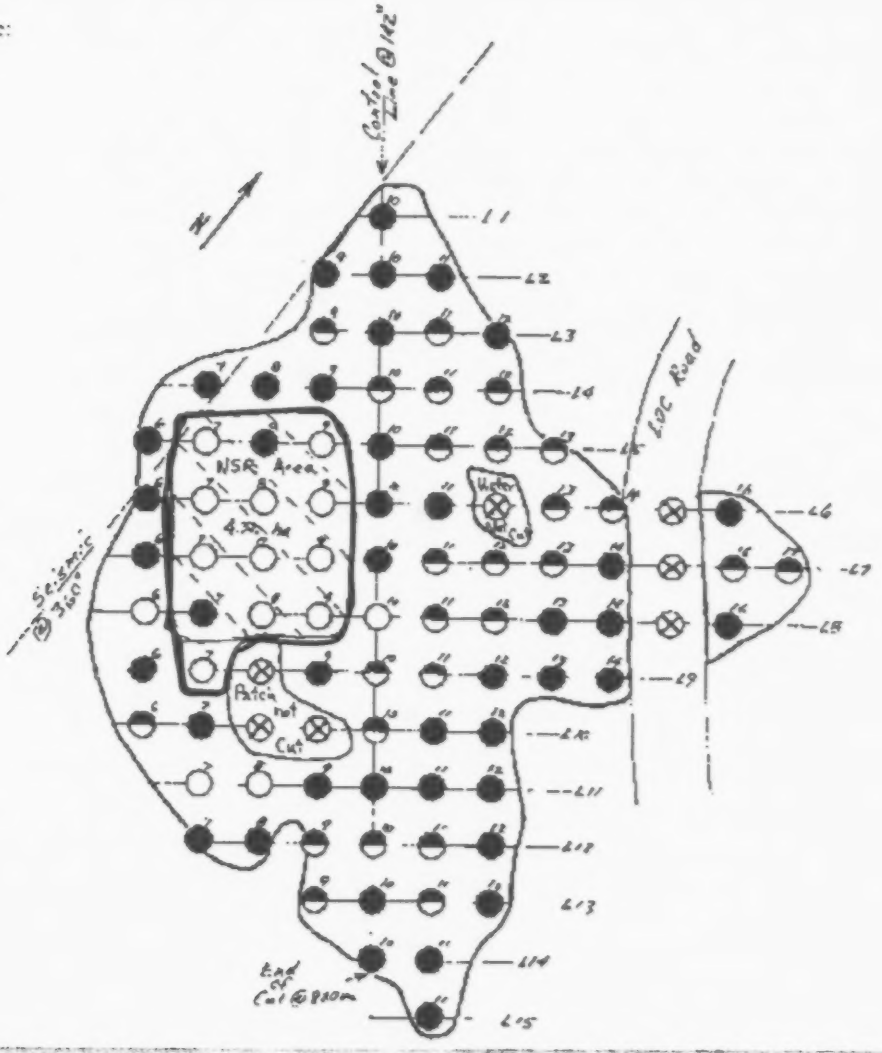
- stocked with Free-to-Grow **(FTG & SR)**

- stocked with performing deciduous crop tree **(SR)**

- stocked with **both** Free-to-Grow coniferous and performing deciduous crop trees **(FTG & SR)**

P - for checking purposes, mark "P" beside those plots on the map that are designated as provisionally FTG

Example:



Disposition	: CTLS030002
Opening Number	: 0761040012
Scale	: 1:5000
Block Area	: 30.5 ha
Survey Date	: May 1, 2000

6.0 Compilation and Survey Submission

6.1 Preparing the final map

The final map to be submitted to the LFD Area Manager must be either drawn on the Map Sheet or generated from a reliable computer program. If the field map and tally cards are neat and complete, they may be submitted, otherwise all information from field tally cards and field maps is to be transferred over to produce a neat, detailed drawing of the cutblock at a reasonable scale (preferably 1:5000). Ensure that all information required, as outlined in Section 5.5 of this manual, is on the map.

6.1.1 Identifying Poor Stocking Distribution

In addition to plot locations and symbols, the map is to show:

For an Establishment Survey:

1. The location and size of stocked areas larger than 2 ha within an otherwise NSR cutblock.

For a Performance Survey:

1. The location and size of Free-to-Grow areas larger than 2 ha within an otherwise not Free-to-Grow cutblock.

The process of delineation of 4 ha patches (NSR holes) will be done using a moving average of plot status, checking in horizontal and vertical rows across the cutblock for areas which do not meet the required 80% stocking level or Free-to-Grow level. The following procedure can be used for both Establishment and Performance Surveys for stocking and Free-to-Grow area delineation:

1. Identifying un-stocked areas within a generally stocked cutblock:
   a. Starting at one corner of the block, proceed along the lines and examine five plots at a time. Five is considered the optimum number because four out of five stocked plots coincides with 80% stocking. After the first five plots have been examined, drop the first plot in the line and add one plot on the end (running average of five plots). Continue progressing to the end of the line until the last five plots have been checked.
   b. A section of five plots is called stocked if four of the plots are stocked. All stocked plots are considered regardless of conifer or deciduous status. A section of five plots is called un-stocked if it contains zero to three stocked plots. If there are fewer than five plots in a line, all plots must be stocked in order to call the whole line stocked. If there are more than five plots in a line, the beginning of the first un-stocked five-plot section and the end of the last un-stocked five-plot section should be marked to select the un-stocked portion of a line (see Appendix 5 for an example).

   After each line is checked and marked, the marked areas should be joined to show the boundaries of the suspected un-stocked areas. The same procedure is to be repeated by running the five-plot, moving average perpendicular to the first direction. An area shown to be NSR in both directions shall be considered the NSR area requiring treatment.

2. Identifying stocked areas within a generally un-stocked block:
   The procedure is the same as for identifying un-stocked areas in a stocked block, except a five plot section is considered stocked only when all the plots are stocked. This means 100% stocking. The procedure described above should not be used to delineate SR/NSR patches that are smaller than 4 ha, and there should be a minimum of 10 plots in the sub-unit. This restriction is necessary because if the number of plots is very small, there is a high probability that the area will be classed incorrectly.

3. Procedure for Wet, Low Density Standard:
   The stocking requirement for Wet, Low Density Standard surveys is 50% rather than 80% on establishment and performance surveys. The procedure is the same as above, except that instead of a five plot running average, a four plot average is used. A section of four plots is called stocked if two or more of the plots are stocked.

Some logical adjustments may be made around the border of the NSR area. When the above procedure has been completed, calculate the area of each NSR patch to determine if any of these are greater than 4 ha. Unstocked portions of generally stocked blocks greater than 4 ha will require reforestation treatment and must be shown on the final map that is submitted to the Forest Area Manager.

Unstocked areas between 2 and 4 ha in size are to be mapped in a manner acceptable to the LFD Area Manager. Areas under LOC are exempt from this procedure.

The area of a NSR patch is to be entered in the "Survey Results" line on the Regeneration Survey Information Sheet.

6.1.2 Roads and Landings Exceeding 5% of Cutblock Area

Compacted areas resulting from roads and landings often regenerate poorly. These areas are to be mapped during the regeneration survey when the area exceeds 5% of the total cutblock area, in a manner acceptable to the Forest Area Manager. While there is no direct effect on the stocking status of the cutblock when the area exceeds 5%, the cutblock is to be included in a population of cutblocks to be analyzed at the time of the next timber supply analysis to ensure that the effect of roads and landings is addressed. Areas under LOC are exempted because they are withdrawn from the cutblock area

The area covered by roads and landings is to be entered in the "Survey Results" line on the Regeneration Survey Information Sheet. Include also the figure for the percentage of the total area of the cutblock that is in roads and landings. To do this, take the area estimated for roads and landings, divide that figure by the total "corrected" area (area of cutblock after survey completed) for the cutblock, and multiply by 100.

6.2 Calculating the Cutblock Stocking Percent and Cutblock Status

6.2.1 Cutblock Stocking Percent

Once any additional plots have been entered (Section 5.4.3), and the individual plot status has been recorded on the tally sheets, the cutblock stocking can be calculated using the Regeneration Survey Summary Sheet on the back of the Map Sheet. The procedure for calculating cutblock stocking percent is the same as outlined in Section 5.4.2.

The final cutblock stocking percent is to be entered in the "Survey Results" area on the Regeneration Survey Information Sheet.

6.2.2 Cutblock Status

There are three requirements for achieving a Satisfactorily Restocked (SR) status (Establishment) or a Free-to-Grow status (Performance) for the cutblock:

- The cutblock stocking percent must be 80% or more, unless the cutblock is a Wet, Low Density standard block where the minimum is 50%, and
- The minimum stocking percentages for deciduous and coniferous must be met, and
- The minimum average density and minimum average deciduous crop tree height must be met (for D standard)

Using the appropriate section in the manual, determine whether the cutblock is Conditionally Restocked (**COND**), Satisfactorily Restocked (**SR**), Free-to-Grow (**FTG**), or Not Satisfactorily Restocked (**NSR**).

The final cutblock status is to be entered in the "Survey Results" area on the Regeneration Survey Information Sheet.

6.3 Submitting Survey Forms and Digital Files

Regeneration surveys completed by the disposition holder must be submitted to the LFD Area Manager on or before **April 30** of the timber year in which they are due. Submission can be either paper or electronic. All regeneration surveys submitted to the LFD Area Manager must be validated by a Regulated Forestry Professional (RFP).

6.3.1 Paper submission to the LFD Area Manager

An acceptable submission for each cutblock contains:

1. Tally sheets and final map with delineation of NSR patches greater than 2 ha and roads/landings where their area is greater than 5% of the cutblock area. These should be contained in one package.
2. Stocking percentages, block status and other survey results data as shown on the Regeneration Survey Information Sheet and on the final Map Sheet.

6.3.2 Electronic Data Submission

An acceptable electronic submission for each cutblock in the Regeneration Survey is as described in the "ARIS Industry Operation Manual, 2001" available through Alberta Sustainable Resource Development. Please contact the Harvesting and Renewal Section of the Forest Management Branch, Land and Forest Division, Edmonton.

7.0 Survey Quality

To ensure all regeneration surveys are accurate and complete all survey submissions to the LFD must be validated by a RFP, and the forest company undertaking the surveys should have a system of check surveying for quality control purposes. Land and Forest Division may also undertake a program of monitoring check surveys. **Any check survey must be carried out by a certified surveyor.** The check survey should be conducted simultaneously with the original survey or, where this is not feasible, during the period that the industry surveyors are still actively carrying out survey work in the same locality.

7.1 Plot-on-Plot Check Regeneration Surveys

For forest industry surveys carried out by certified surveyors, the check survey method used will be the "plot-on-plot" method. A minimum of 25 plots should be checked in each block chosen for checking.

A demerit system is used to recognize the relative importance of various infractions or inadequacies. The primary intent of the demerit process is not to penalize but to assist in ensuring accuracy to the collection and articulation of data in the survey. A maximum of four demerit points will normally be allowed before a survey is rejected. Details of criteria for demerit points are itemized below as 'standards of accuracy' for surveys. If the checker assesses more than four demerit points before checking all 25 plots, the survey fails and the checker need not continue with the rest of the check survey in that cutblock.

If the regeneration survey is found to be below standard during a check survey, the entire survey of blocks in a given area might be rejected based on the judgement of the check surveyor with the concurrence of the responsible forest company RFP.

7.2 Standards of Accuracy for Surveys

Deductions are as follows:

a. One demerit for each missed crop tree for the declared strata and species representative seedling or sapling. It is important that all chosen crop trees be clearly ribboned for checking purposes.
b. One demerit for tallying an unacceptable crop tree e.g., advance growth that should not have been tallied, dead leaders on seedlings, unhealthy seedling, more than two multiple stems, layered, damaged seedlings.
c. One and one half demerits for tallying a tree that is outside the plot.
d. One demerit for incorrectly identifying a species; e.g., calling balsam fir a spruce, etc.
e. Half demerit for inaccurate plot establishment. Ten percent error is allowed in plot spacing and line spacing.
f. Half demerit for not tying into the control line. **This demerit will be applied only once.**

g. Half demerit for incorrect delineation of NSR areas. **This demerit will be applied only once.**
h. Half demerit for incorrect numbering of plots or lines.
i. Half demerit for incorrect stocking grid pattern and/or incorrect map symbols. **This demerit will be applied only once.**
j. Half demerit for not correctly marking plot centres in the field.
k. Half demerit for inaccurate density estimate or not recording density of trees on the plot. Variance to be ±2 trees if total less than 10 trees or ±10% if estimated total greater than 10 trees.
l. One demerit for poor mapping quality. This will also include missed information on final map. **This demerit will be applied only once.**
m. One demerit for inaccurate crop tree height or diameter measurement. Height should be to the nearest centimetre and should be taken from the base of the seedling/tree, at average ground level to the top of the farthest reaching living matter of the seedling/tree. Diameter should be measured just above the collar node (or butt swell) and recorded to the nearest millimetre (0.1cm).

Unless otherwise indicated, demerits will be applied on a "per occurrence" basis.

7.3 Rejection of Survey

a. More than four (4) demerit marks will normally constitute grounds for rejection of a cutblock survey.
b. Considering the seriousness of including seedlings from outside the plot boundary, two such errors will constitute grounds for rejection of the cutblock survey.

Rejection of one or more cutblock surveys may constitute grounds for rejection of all cutblocks surveyed by a particular surveyor or contractor. The decision to reject a survey and implications of that rejection to the responsible company RFP rests with LFD Area Manager in consultation with the RFP. Recommendation to the Land and Forest Division for the suspension of a surveyor's certification may also result.

Appendices

Appendix 1

Glossary

Advance Growth:	A tree that was established in advance of harvest and which meets all the standards for acceptability.
Arithmetic mean:	The average obtained by dividing the sum of the items by the number of individual items.
Buffer:	An area of forest or vegetative cover that is left in a natural state on the landscape usually to provide protection for some natural feature or serve as a wildlife corridor.
Competitor:	A broadleaved tree or woody shrub that exceeds the limits for height relative to the height of a conifer tree and is growing within a specified distance of a potential coniferous crop tree.
Conditional seedling:	A coniferous tree on a deciduous establishment survey which does not meet the height requirements but does meet the other requirements of age, form, and health.
Coniferous:	Needle-leafed trees which produce cones, (includes larch spp.)
Control line:	A line established at 400 m intervals for control of plot location. The control line runs across the long axis of the cutblock and is marked at points where survey lines cross it.
Coppice:	A natural regeneration process similar to suckering where the seedling or sapling regenerates from the cut or damaged stump. A number of healthy stems may be observed coming from one stump. Found primarily in birch, but also in other hardwood species.
Crop tree:	A crop tree is the tallest seedling/tree on the plot that has achieved the minimum height requirements as defined in the standards for the type of survey and the tree species.
Deciduous:	Broadleaved tree species that lose their leaves in the fall.
Demerit:	Demerits are deductions given as a result of errors committed when performing a regeneration survey and are determined by the check survey. More than four (4) demerit marks will normally constitute grounds for failure of the survey.
Density:	The number of trees on the plot, by species, greater than or equal to 30 cm in height. The density for survey purposes is usually expressed as trees per plot. The average density for each species is the sum of the trees recorded on every plot, divided by the total number of plots. The density measurement also constitutes part of the deciduous standard.
DFMP:	Detailed Forest Management Plan prepared by the timber operator.
Disposition:	The legal document that provides the timber rights to harvest the timber to the disposition holder.

Forest Area:	A geographic administrative unit within a Region Forest Area of Alberta.
Drainage class:	Actual water content in excess of field moisture capacity, and the extent during which such excess water is present in the plant rooting zone. Seven classes are provided, ranging from very rapidly to very poorly drained.
Establishment:	The Establishment survey is the first survey required after harvesting. The survey must be carried out 4 to 8 years after harvesting.
Field number:	The number assigned to a cutblock and which normally appears on the AOP map of harvest plan map.
FMA:	Forest Management Agreement
FMU:	Forest Management Unit
Free-to-Grow:	A crop tree that has achieved the minimum height requirements and has up to the allowable limit of competitor trees and shrubs with the FTG cylinder as defined in the standards for the type of survey and the tree species.
Horizontal projection:	A flat view of the ground that is corrected for the additional and area created by topographic features.
Hybrid:	The offspring of two plants of different varieties. They are the result of tree improvement programs to improve the growth or other characteristics of the native varieties.
Landing:	An area, or number of areas, found on a cutblock where harvested logs are temporarily stored until they can be hauled. Landings are usually associated with cutblock logging roads and may experience different regeneration results due to possible compaction of the soil from log piles.
Leader:	The top growth on a seedling which results from the current or past year one year growth.
Natural sub-region:	A geographic area, containing sites with similar characteristics, and defined by plant species composition and abundance of reference ecosites.
NSR:	Not satisfactorily restocked according to the definitions described in the Regeneration Survey Manual for the type of survey, species, height, etc. The term may refer to an individual plot, a portion of a cutblock, or an entire cutblock.
Opening number:	A unique number assigned to a cutblock based on the legal location of the centre of the harvest area (stand opening).
Overlapping plot:	A plot which contains both a coniferous crop tree and a deciduous crop tree.
Performance:	The Performance survey is designed to ensure established trees are performing to specified standards and are likely to develop into stands that will meet management objectives. The survey must be carried out 8 to 14 years after harvesting.

Provisionally FTG plot	Contains a conifer crop tree that meets the minimum performance indicator requirements for its species group and that also has up to the allowable level of competitors within the FTG cylinder
Re-classified Strata Standard:	In some situations, the disposition holder may be allowed to change the original strata standard for an area harvested.
Riparian area:	A terrestrial area where the vegetation and microclimate are highly influenced by perennial and/or intermittent water, associated high water tables and soils that exhibit some wetness characteristics.
Root collar:	The base of a seedling where the root ends and the stem begins. Sometimes characterized by a node.
Sample plot:	A regeneration survey sample plot is 1/1000 ha or 10m2 in size, circular in shape. It has a radius of 1.78m.
SR:	Satisfactorily restocked according to the definitions described in the Regeneration Survey Manual for the type of survey, species, height, etc. The term may refer to an individual plot, a portion of a cutblock, or an entire cutblock.
Stocking %:	The sum of all the satisfactorily restocked plots on the cutblock, divided by the total number of valid plots, multiplied by 100 to express term as a percent. Stocking of conditional conifers on a deciduous Establishment survey is limited to 20%.
Strata Standard:	A cutblock is placed in one of 4 strata standards (C, CD, DC, or D). The individual is referred to as the stratum.
Survey line:	Survey lines run perpendicular to the control lines, parallel with each other and at a calculated spacing. Plots are located along the survey line.
Timber Year	The period of time between May 01 and April 30 of the following calendar year
Tree height:	The height of a seedling or sapling is measured from the base of the tree at the ground level, to the uppermost point of the living tissue in the tree.
Valid Plot:	A plot within the Regeneration Survey that is established via a field grid and is assessed for its attributes in order to establish it's stocking condition and the density of trees on it. A "Deleted Plot" is not a Valid Plot.

Appendix 2

Statistical Accuracy Standards

The systematic survey method has been designed to satisfy the statistical accuracy standards outlined below. The error levels are inherent in the survey design and do not include error on the part of the surveyor. Accuracy will be further reduced if human error, either by omission or commission, is introduced into the sampling.

The sampling error for an individual cutblock can be calculated using the formula:

$$E = +/- 200 \sqrt{\frac{p \times q}{n}}$$

Where : E = Sampling error in percent
p = proportion of stocked plots expressed as a decimal, e.g., 70% = 0.70
q = 1-p; proportion of plots unstocked as a decimal, e.g., 1.00- 0.70 = 0.30
n = number of plots established

The following table presents the statistical accuracy agreed to for Alberta Regeneration Surveys:

CUTBLOCK SIZE (ha)	STATISTICAL ACCURACY
0 – 0.9	Variable
2 – 4	Within +/- 12.5% with 95% confidence
4 +	Within +/- 10.0% with 95% confidence when stocking is 80% or greater

Appendix 3

Number of Sample Plots Required

The total number of plots required to sample any given area can be calculated using the formula:

$$n = 40{,}000 \sqrt{\frac{p \times q}{E^2}}$$

Where : n = number of sample plots to be established
p = proportion of plots stocked expressed as a decimal
q = 1 - p; proportion of plots unstocked expressed as a decimal
E = maximum allowable sampling error, which must not exceed:
+/- 10.0% for cutblocks larger than 4 ha
+/- 12.5% for cutblocks 2 to 4 ha where the stocking result indicated by the survey is 80% or more

The values of p and q are not known for the area prior to survey, so an assumed stocking value of 80% is to be used.

CUTBLOCK SIZE:	SAMPLE PLOTS:
0.1 – 1.9 ha	Min. 12.4 plots/ ha
2.0 – 4.0 ha	Initially 41 plots/ cutblock 41 plots: If stocking 0- 72% or 80- 100% 54 plots: If stocking 73- 79%
4.1 – 24.0 ha	Initially 64 plots/ cutblock 64 plots: If stocking 0- 72% or 80- 100% 84 plots: If stocking 73- 79%
24.0+ ha	Min. 2.77 plots/ ha

Appendix 4

Line and Plot Spacing

Survey Line and Sample Plot Spacing

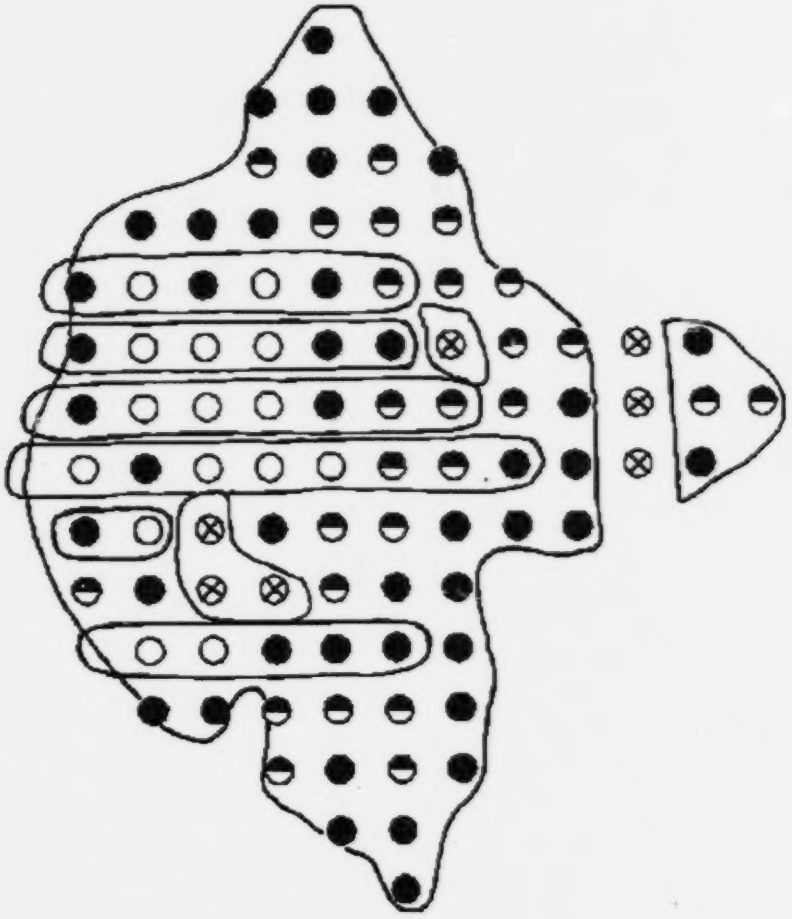
Hectares	Square Metres per plot	Square Spacing in Metres	Plots/Ha	Allowable Error	Number of Plots
0.5	806.45	28.40	12.40	32.66	6
1.0	806.45	28.40	12.40	22.19	12
1.5	806.45	28.40	12.40	18.35	19
2.0	487.80	22.09	20.50	12.50	41
2.5	609.76	24.69	16.40	12.50	41
3.0	731.71	27.05	13.67	12.50	41
3.5	853.66	29.22	11.71	12.50	41
4.0	975.61	31.23	10.25	12.50	41
4.5	703.13	26.52	14.22	10.00	64
5.0	781.25	27.95	12.80	10.00	64
5.5	859.38	29.32	11.64	10.00	64
6.0	937.50	30.62	10.67	10.00	64
6.5	1015.63	31.87	9.85	10.00	64
7.0	1093.75	33.07	9.14	10.00	64
7.5	1171.88	34.23	8.53	10.00	64
8.0	1250.00	35.36	8.00	10.00	64
8.5	1328.13	36.44	7.53	10.00	64
9.0	1406.25	37.50	7.11	10.00	64
9.5	1484.38	38.53	6.74	10.00	64
10.0	1562.50	39.53	6.40	10.00	64
10.5	1640.63	40.50	6.10	10.00	64
11.0	1718.75	41.46	5.82	10.00	64
11.5	1796.88	42.39	5.57	10.00	64
12.0	1875.00	43.30	5.33	10.00	64
12.5	1953.15	44.19	5.12	10.00	64
13.0	2031.25	45.07	4.92	10.00	64
13.5	2109.38	45.93	4.74	10.00	64
14.0	2187.50	46.77	4.57	10.00	64
14.5	2265.63	47.60	4.41	10.00	64
15.0	2343.75	48.41	4.27	10.00	64
15.5	2421.88	49.21	4.13	10.00	64
16.0	2500.00	50.00	4.00	10.00	64
16.5	2578.13	50.78	3.88	10.00	64
17.0	2656.25	51.54	3.76	10.00	64
17.5	2734.38	52.29	3.66	10.00	64
18.0	2812.50	53.03	3.56	10.00	64
18.5	2890.63	53.76	3.46	10.00	64
19.0	2968.75	54.49	3.37	10.00	64
19.5	3046.88	55.20	3.28	10.00	64
20.0	3125.00	55.90	3.20	10.00	64

Hectares	Square Metres per plot	Square Spacing in Metres	Plots/Ha	Allowable Error	Number of Plots
20.5	3203.13	56.60	3.12	10.00	64
21.0	3281.25	57.28	3.05	10.00	64
21.5	3359.38	57.96	2.98	10.00	64
22.0	3437.50	58.63	2.91	10.00	64
22.5	3515.63	59.29	2.84	10.00	64
23.0	3593.75	59.95	2.78	10.00	64
23.5	3671.88	60.60	2.72	10.00	64
24.0	3750.00	61.24	2.67	10.00	64
24.5	3610.11	60.08	2.77	9.71	68
25.0	3610.11	60.08	2.77	9.61	69
25.5	3610.11	60.08	2.77	9.52	71
26.0	3610.11	60.08	2.77	9.43	72
26.5	3610.11	60.08	2.77	9.34	73
27.0	3610.11	60.08	2.77	9.25	75
27.5	3610.11	60.08	2.77	9.17	76
28.0	3610.11	60.08	2.77	9.08	78
28.5	3610.11	60.08	2.77	9.00	79
29.0	3610.11	60.08	2.77	8.93	80
29.5	3610.11	60.08	2.77	8.85	82
30.0	3610.11	60.08	2.77	8.78	83
30.5	3610.11	60.08	2.77	8.70	84
31.0	3610.11	60.08	2.77	8.63	86
31.5	3610.11	60.08	2.77	8.56	87
32.0	3610.11	60.08	2.77	8.50	89
32.5	3610.11	60.08	2.77	8.43	90
33.0	3610.11	60.08	2.77	8.37	91
33.5	3610.11	60.08	2.77	8.30	93
34.0	3610.11	60.08	2.77	8.24	94
34.5	3610.11	60.08	2.77	8.18	96
35.0	3610.11	60.08	2.77	8.12	97
35.5	3610.11	60.08	2.77	8.07	98
36.0	3610.11	60.08	2.77	8.01	100
36.5	3610.11	60.08	2.77	7.96	101
37.0	3610.11	60.08	2.77	7.90	102
37.5	3610.11	60.08	2.77	7.85	104
38.0	3610.11	60.08	2.77	7.80	105
38.5	3610.11	60.08	2.77	7.75	107
39.0	3610.11	60.08	2.77	7.70	108
39.5	3610.11	60.08	2.77	7.65	109
40.0	3610.11	60.08	2.77	7.60	111
40.5	3610.11	60.08	2.77	7.55	112
41.0	3610.11	60.08	2.77	7.51	114
41.5	3610.11	60.08	2.77	7.46	115
42.0	3610.11	60.08	2.77	7.42	116

Hectares	Square Metres per plot	Square Spacing in Metres	Plots/Ha	Allowable Error	Number of Plots
42.5	3610.11	60.08	2.77	7.37	118
43.0	3610.11	60.08	2.77	7.33	119
43.5	3610.11	60.08	2.77	7.29	120
44.0	3610.11	60.08	2.77	7.25	122
44.5	3610.11	60.08	2.77	7.21	123
45.0	3610.11	60.08	2.77	7.17	125
45.5	3610.11	60.08	2.77	7.13	126
46.0	3610.11	60.08	2.77	7.09	127
46.5	3610.11	60.08	2.77	7.05	129
47.0	3610.11	60.08	2.77	7.01	130
47.5	3610.11	60.08	2.77	6.97	132
48.0	3610.11	60.08	2.77	6.94	133
48.5	3610.11	60.08	2.77	6.90	134
49.0	3610.11	60.08	2.77	6.87	136
49.5	3610.11	60.08	2.77	6.83	137
50.0	3610.11	60.08	2.77	6.80	138

Appendix 5

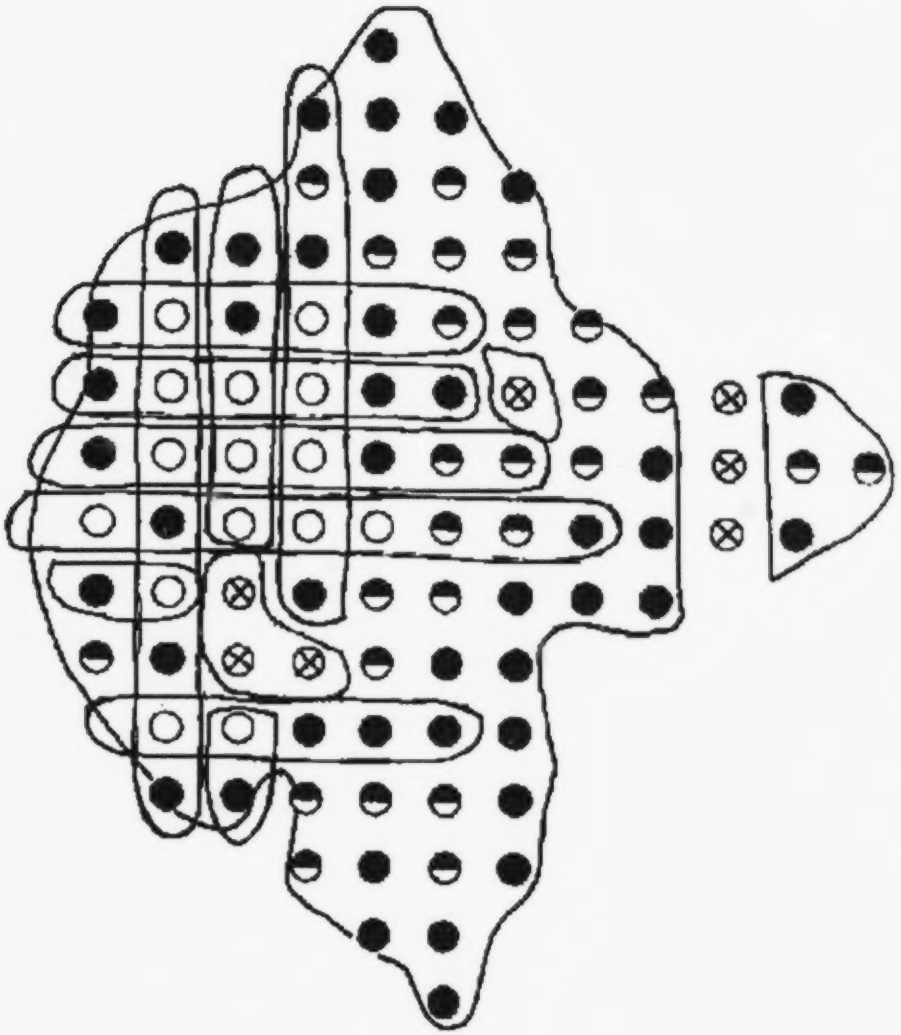
Delineating NSR areas larger than 2 ha (examples)



Step 1: Example of west to east delineation of suspected NSR area

CD – ESTABLISHMENT SURVEY

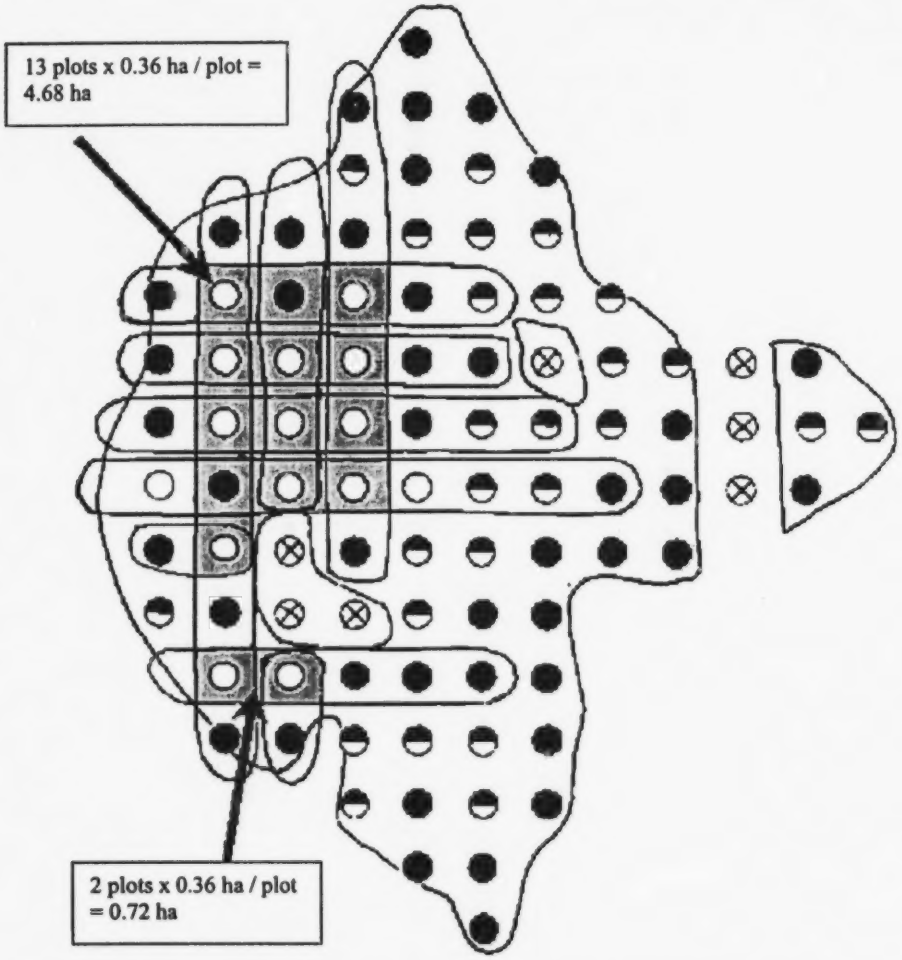
Block Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
NSR	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
	Stocking Percent	= 82.14%



Step 2: North to south delineation of suspected NSR area

CD – ESTABLISHMENT SURVEY

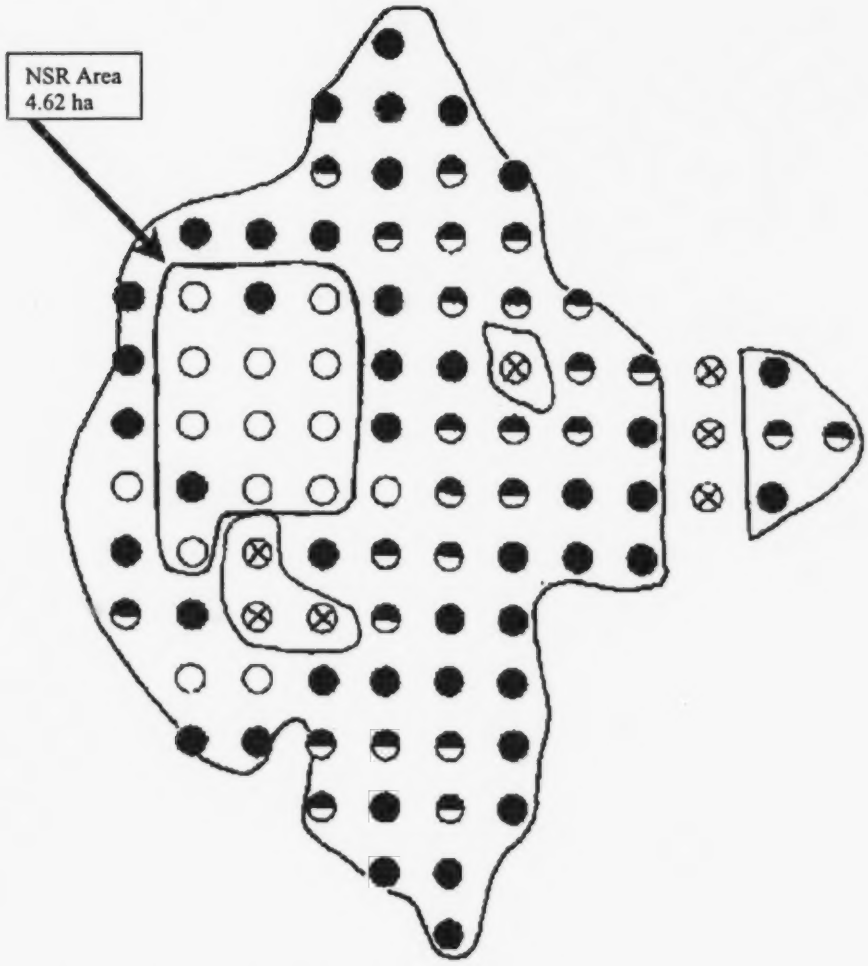
Block Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
NSR	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
Stocking Percent		= 82.14%



Step 3: Overlapping area following east-west and north-south delineation of suspected NSR area.

CD – ESTABLISHMENT SURVEY

Block Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
NSR	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
Stocking Percent		= 82.14%



Step 4: NSR area greater than 4.0 ha identified on cutblock map.

CD – ESTABLISHMENT SURVEY

Block Area	- 30.5 ha	
Valid Plots	- 84 plots	
Grid 60 x 60m	- 0.36ha/plot	
NSR	- 15 plots	
SR- Coniferous	- 43 plots/ 84	= 51.19%
SR- Deciduous	- 26 plots/ 84	= 30.95%
Stocking Percent		= 82.14%

This block is NSR by virtue of the > 4 ha contiguous NSR area.

Appendix 6

Species Acronym Table

COMMON NAME	SPECIES ACRONYM
White spruce	Sw
Black spruce	Sb
Englemann Spruce	Se
Lodgepole pine	Pl
Jack pine	Pj
Whitebark pine	Pw
Limber pine	Pf
Tamarack	Lt
Alpine larch	La
Western larch	Lw
Siberian larch	Ls
Douglas-fir	Fd
Balsam fir	Fb
Alpine fir	Fa
Trembling aspen	Aw
Balsam (Black) poplar	Pb
White birch	Bw
Hybrid poplar	Ax

Alberta Regeneration Survey Manual

Regeneration Survey Manual in Adobe Acrobat (.pdf) Format (520KB)

Regen Manual QA (.pdf) Format (32KB)

Appendix 7 in Adobe Acrobat (.pdf) Format (458KB)

List of Manual Changes July 03 (.doc) Format (38KB)

Tally Sheets in Microsoft Excel (.xls) Format

Tally Sheets 1-4 (78KB)

Alberta Regeneration Survey Manual

QUESTION & ANSWER SHEET

February 2005

The following Q&A was developed in response to inquiries regarding the Alberta Regeneration Survey Manual (May 1, 2003 version). This Q&A covers only those issues pertaining to clarification or interpretation of portions of the Survey Manual.

Q:	What constitutes a "deciduous competitor"? What if the deciduous tree/shrub is heavily browsed, is diseased or has multiple stems, etc.?
A:	A deciduous competitor is any woody broadleaved vegetation (i.e. broadleaved deciduous tree or shrub) that is *alive* (health or form is irrelevant), within 1.78m of the coniferous crop tree, and: 1. Is greater than or equal to 2/3 the height of the coniferous crop tree (for Performance Surveys completed in years 8-11), or 2. Is greater than or equal to the coniferous crop tree height and where the base diameter is at least 70% of that of the crop tree (for Performance Surveys completed in years 12-14).
Q:	How exactly are deciduous stems tallied and measured when sprouts are growing from a cut or damaged stump (i.e. coppice growth)? Does each sprout count as an individual stem, or do you count the whole coppice as a single stem? Where do you measure RCD?
A:	*Each* (live) sprout growing from a cut or damaged stump counts as an individual stem, whether as a deciduous crop tree or as a deciduous competitor (provided the relevant criteria are met). RCD (root collar diameter) is measured: ▪ On the selected sprout/stem, as close to the original stump as possible in the case of two or more sprouts, or ▪ On the original stump, in the case of a single sprout.

Q:	Do you delete survey plots that fall on "linear disturbances" such as in-block roads, landings and seismic lines?
A:	Not unless they are under disposition. Otherwise, in-block roads and seismic lines are considered to be 'temporary' deletions and must be reforested. Therefore, any plots landing on these disturbances are not deleted nor moved. Plots are only deleted when they fall on areas that have been "netted" out of the block as 'permanent' deletions, since the number of plots and grid are calculated on the *reduced* block area. 'Permanent' deletions (i.e. that won't be reforested and don't contribute to AAC) include dispositions (e.g. LOC's, MLL's, PLA's, well sites, etc.) and non-harvested areas in the block (e.g. riparian buffers or retention patches – no stumps!). If a surveyor finds 'permanent' deletions in the block that are not accounted for in the net block area used to calculate the number of plots and the grid, then the surveyor *moves* (not deletes) any plot landing in one of these areas by half the plot distance until it can be established.
Q:	When calculating the number of plots and survey grid, should I delete recently reclaimed (rolled-back) roads and landings from the block area?
A:	No. Unless under disposition, these areas are not considered to be 'permanent' deletions. Therefore, they must be reforested and not "netted" out of the block area to be surveyed.
Q:	The Standards for Accuracy for Surveys (Section 7.2 (b)) says there is a demerit assessed if a crop tree is tallied having more than two multiple stems. Isn't an acceptable crop tree allowed to have three?
A:	Yes, a coniferous crop tree is allowed to have not more than two multiple stems originating at the base, or not more than three lateral shoots not originating from the base. Section 7.2 (b) does not contain an exhaustive list of items that make a crop tree unacceptable.

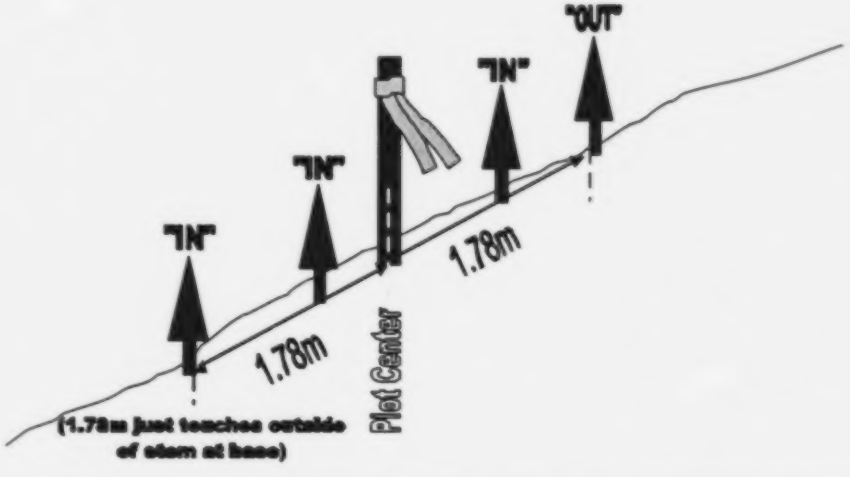
Q: How do you really count what is "in" the plot (or FTG cylinder)? Does the plot (or cylinder) center start at the outside of the plot stick (or crop tree), or at the middle of it? Is a tree or competitor "in" if the 1.78m radius touches the outside bark or if it covers ½ the diameter of the stem? What if the tree is leaning?

A: Plots (and cylinders) are to be measured as 1.78m from **"center to outside"**, *at the base* (ground level). That is,

- the center of the plot to the outside of the crop tree stem, *or*
- the center of the crop tree stem to the outside of the competitor stem,

at the base of each.

This method negates the potential effects of leaning trees and the effect of plot stick (or crop tree) diameter on plot (or cylinder) size, while still simplifying the survey method. Slope correction is not of real concern to SRD for the small 1.78m plot/cylinder radius.



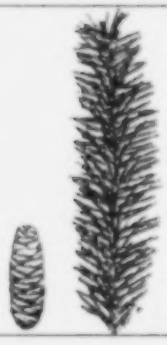
Appendix 7

Species Identification

Picea glauca

White spruce

Leaves: Needle-shaped, four-sided, 2-3 cm long, straight, stiff, sharp pointed, bluish-green, aromatic when crushed.

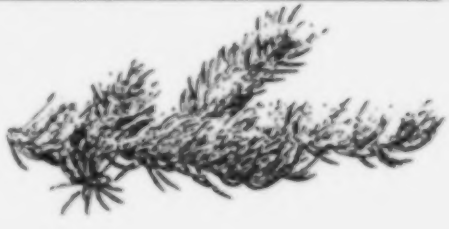


Picea englemannii

Englemann spruce

Leaves: Broad needle-shaped, about 2 cm long, stiff, blunt or sharp pointed, curved, four-sided in cross-section, bluish-green but often with a whitish bloom; aromatic when crushed; a strong tendency to point towards the upper side and end of the twig.

Twigs: More or less hairy, grayish to light brown; outer bud-scales shorter than the bud, not usually projecting beyond its tip.



Picea mariana

Black spruce

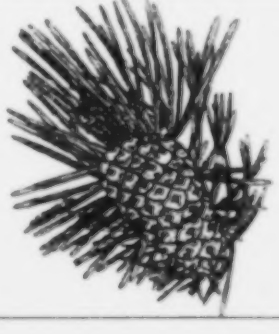
Leaves: Needle-shaped, four-sided, 1-2 cm long, straight, thick, stiff, blunt, bluish green in color.

Twigs: Hairy, brown

Pinus contorta v. latifolia

Lodgepole pine

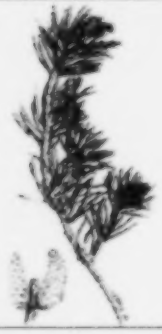
Leaves: Needle-shaped in bundles of 2, 2.5-8 long, spirally twisted, stiff, very sharp pointed, yellowish-green, forms dense cluster towards the end of twigs.



Pinus banksiana

Jack pine

Size: In closed stands on favourable sites, it reaches 27 m in height, with a straight trunk 60 cm. in diameter but, normally, it is 14-20 m in height and 20-30 cm in diameter.
Leaves: Pointed, light, yellowish-green, spread apart, the edges toothed; clusters with persistent basal sheaths.

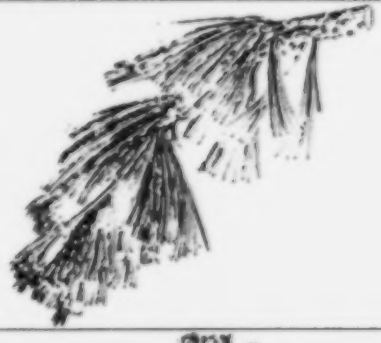


Pinus albicaulis

Whitebark pine

Leaves: In 5's, 4-9 cm long, needle-shaped, stout, stiff, slightly curved, bluish-green, the edges not toothed, clustered towards the ends of the branchlets.

Twigs: Stout, tough, usually hairy, reddish-brown to chalky-white; buds oval, sharp pointed, with overlapping loose scales.



Pinus flexilis

Limber pine

Leaves: In 5's, 4-9 cm long, needle-shaped, stout, stiff, slightly curved, bluish-green, the edges not toothed, clustered towards the ends of the branchlets.

Twigs: Stout, tough, at first hairy, later smooth; greenish-yellow becoming gray; buds oval, pointed, with overlapping loose scales.

Larix laricina

Tamarack

Leaves: Needle-shaped in feather-like clusters of 10-20, 2-4 cm long, soft, flexible, pale green turning bright yellow in autumn. Sheds leaves in autumn.

Psudotsuga mensiesee

Douglas-Fir

Leaves: Linear, 2-3 cm long, often sharp pointed, soft, bright yellowish-green, paler below, standing out from three sides of the twig and appearing two-ranked.

Twigs: Slender, flexible; buds conical, sharp pointed, shiny reddish-brown.

Abies balsamea

Balsam fir

Leaves: Needle-shaped, flattened, 2-3 cm long, bent upward, rounded or blunt tipped, dark shiny green surface and whitish underside.

Abies lasiocarpa

Alpine fir

Leaves: Grayish-green to pale bluish-green above and below, with many markings (stomata) on both surfaces, 2-4 cm long, rounded or notched at the tip, curved upwards to stand almost erect along the twig, crowded, seldom two-ranked; resin canals in the internal tissue as viewed in the cross-section of the leaf.

Twigs: Stout, hairy, brownish, becoming grayish but retaining the hairiness usually for several years; buds 0.5 cm long, rounded and covered with wax-like resin.

Populus tremuloides

Trembling aspen, white aspen

Leaves: Alternate simple, rounded, abruptly pointed at tip, 4-6 cm wide. Teeth on margin fine, irregular, rounded. Leaf stem slender, flattened, usually longer than the leaf-blade, shiny deep green on top, paler under.

Populus balsamifera

Balsam poplar

Leaves: Alternate, simple, egg-shaped, tapering to a sharp-pointed tip, 8-15 cm long, shiny deep green surface, whitish-green underside sometimes with rusty brown resin stains. Teeth on margin fine, irregular, rounded.

Betula papyrifera

White birch

Leaves: Alternate, simple, egg-shaped, 2-9 cm long, dull green upper surface, paler, slightly hairy underside. Margins toothed except near the base.

Alnus crispa

Green alder

Leaves: Alternate, simple, ovate, 2- 8 cm long, fine, sharp teeth on margins, prominent veins, shiny green upper surface, paler underside, sticky when young.

Fruit: Small cone-like catkins on long stalks, several in a cluster, green turning brown at maturity. Nutlets with wings.

Salix spp.

Willows

Leaves: Alternate simple, long, narrow, and pointed at both ends. Teeth on margins.

Note: Various species will be encountered which may make identification difficult.

Summary of Regeneration Survey Changes effective May 2003:

A recent review of the Regeneration Survey standards was carried out and resulted in a number of changes to the Regeneration Survey Manual (RSM). The following is a summary, grouped by section number, of the substantive changes made to the RSM. In addition to these changes, several editorial changes have been made to improve clarity and readability of the manual.

1. Change to Date Printed: now reads *"July, 2003"*.

2. **Section 1.6; Qualifications of Surveyors;** removed reference to a certified surveyor having to meet the field experience requirement of five surveys. All that a surveyor student needs to do to obtain certification is pass the field exam of the regeneration survey course.

3. **Sections 2.1.3, 2.2.3, 2.3.3, 2.4.3, 3.1.3, 3.2.3, 3.3.3, and 3.4.3; Crop Trees:**

   The definition of an acceptable conifer crop tree and advanced growth has been restructured editorially. All parameters remain the same as they were in the past with no changes to the definition. The reason for the editorial change is an attempt to clearly articulate the crop tree definition for the user.

   Within these same sections, at the bottom of each of that section's "species tables", appears a statement concerning the use of fir. The last line in the "fir statement" has been edited and will now read: *"The acceptability of fir on a block by block basis is determined prior to survey."*.

   Within the Deciduous Standard, in the Establishment Survey only, section 2.4.3, appears a definition for a conditional coniferous tree. This has been edited to read as follows: *"A **conditional coniferous tree** is a specific seedling/tree that meets all of the criteria for a crop tree (section 2.4.3), has achieved the minimum height requirement specified in Table 2.12 for conditional coniferous trees, but has not achieved the minimum crop tree height."*.

4. **Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1; Timing of Survey (Performance Survey ONLY):**
   An additional timing constraint has been added that the survey may not be completed within 2 growing seasons after a stand tending treatment is completed.

5. **Sections 3.1.3, 3.2.3, 3.3.3; Crop Trees (Free-to-Grow components):**
   Four changes have been made to the Free-to-Grow assessments in the Performance survey.

   (1) The FTG assessment area has been standardized to 1.78m radius for all standards and crop tree species – changed from the 2.0 m radius for all pine crop trees and crop spruce (C standard) and the 1.5 m for spruce crop tree in mixedwood blocks.

(2) The definition of a 'competitor' that is to be counted against meeting the FTG standards has been altered depending on the timing of the Performance Survey.

For surveys conducted between 8-11 years after harvest:

i) any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and

ii) that is equal to or greater than 2/3 the crop tree height

For surveys conducted between 12-14 years after harvest:

i) any woody broadleaved vegetation that is within 1.78m (stem to stem) of the conifer crop tree, and

ii) that is equal to or greater than the crop tree height, and,

iii) with a base diameter equal to or greater than 70% of the conifer crop tree root collar diameter

3) The addition of a "provisional" free-growing status for crop trees defined by the tree meeting specific performance indicators and the competition assessment area having less then a specified number of quadrants containing competitors. The table below summarizes the PI threshold values and the number of quadrants in the assessment area allowable by species and reforestation standard.

Species	**Performance Indicators**	**Allowable area of cylinder with competitors**
Spruces, firs "C" standard	Last 2 year leader increment (total) => 60 cm OR total height => 2.5m	Competitor trees/shrubs in one or two of four quadrants
Spruces, firs "CD" or "DC" standards	Last 2 year leader increment (total) => 60 cm OR total height => 2.5m	Competitor trees/shrubs in two of four quadrants
Pines, larches	Height:diameter ratio < 55 OR total height =>3.5m	Competitor trees/shrubs in one of four quadrants

(4) Provisionally FTG plots may be used in the calculation of the required minimum stocking levels according to the following maximum countable proportions. Provisionally FTG trees in excess of the allowable limits shown below are considered to be NSR.

Reforestation Standard	Total Provisional	Provisional Spruces	Provisional Pines
C	30%	30%	10%
CD	25%	25%	10%
DC	15%	15%	10%

6. It was discovered in these new Free-to-Grow sections, specifically the tables, that there were some minor editorial mistakes, a typo and a missing word, in the May 2003 version that have since been corrected in the updated version.

7. **Section 5.1.2: Cutblock Description and Survey Type; Opening Number:** should read as follows: *"....The official cutblock number used by Land and Forest Division for record keeping, tracking and future reference……."*.

8. **Section 5.1.2: Survey Grid; second bullet, second line**: correct the word "he" to "the".

9. **Section 5.3.3.1: Competitor trees/shrubs (Performance Survey):** First paragraph: the last line is **removed** – ("…The competitor tree or shrub must be flagged for the purpose of checking.").

10. **Section 5.3.5, second paragraph, first bullet, should read:** *"... If the seedling was planted prior to June 21, the growing season in the year...."*.

11. **Section 5.3.6; RCD (Root Collar Diameter)**
Root collar diameter of crop trees in now mandatory only at the Performance Survey, the requirement for this measure at the Establishment Survey has been dropped. In addition, where vegetation that is in excess of the crop tree height is to be classed as "non-competing" its RCD must be less than 70% of the crop tree. For checking purposes, the competitor RCD must also be recorded. RCD measurements of trees or shrub with multiple stems from a single base are to be made on what appears to be the largest diameter stem.

12. **Section 5.3.6: RCD (Root Collar Diameter); remove the first paragraph and replace with the following:**

> *"Root Collar Diameter (RCD) is a required measurement for a conifer crop tree, in the 'Pines/Larches" category, in the Performance Survey only. If a Performance Survey is being done 12 – 14 years after harvest, a RCD measurement is required on the designated competition tree/shrub."*

Section 5.3.6: RCD; second paragraph, second-last line should read:
"...point where the butt swell taper disappears and normal bole width is encountered (see figure 3)...".

Section 5.3.6: RCD; additional paragraph to read: *"If measuring RCD on competition species of trees or shrubs with multiple stems from a single base, choose what appears to be the largest diameter stem and take the measurement from there.".*

13. **Section 5.3.11: Density; first paragraph, third line should read:** *"...that species on the same line as the species representative that was recorded originally on the left side.....".*

14. **Addition of a Section 5.3.12, entitled:** *Additional Columns on the Tally Sheet.* Also, addition to that paragraph of a line that reads: *" As well, certain companies or clients may choose to add specific data sets to a "tailored" version of the tally sheet.".*

15. Section 5.3.13, part 6: Cutblock Status: change "CRS" to "CSR".

16. **Section 5.4.2, Performance Stocking, part 2, additional line at the end of that part reads:** *"...but do not count any plot more than once.".*

17. **Section 6.2.2, second paragraph, second line should read:** *"....Conditionally Restocked (CSR), Satisfactorily Restocked (SR), Free-to-Grow (FTG)....".*

18. **Section 6.3 Submitting Survey Forms and Digital Files:**
The date of submission has been changed and a new requirement for RFP signatures has been added as follows: "Regeneration surveys completed by the disposition holder must be submitted to the LFD Area Manager on or before **April 30** of the timber year in which they are due. Submission can be either paper or electronic. All regeneration surveys submitted to the LFD Area Manager must be validated by a Regulated Forestry Professional (RFP).".

19. **7.0 Survey Quality**
Changes to the quality assessment section have been made. Surveys are "validated" once signed by a RFP and submitted to the Area Manager. While LFD retains the right to conduct spot audits of any submitted regeneration survey, the 10% minimal proportion of check surveys will no longer be conducted by LFD. Companies having regeneration surveys conducted are required to have a system of check surveys in place to ensure survey quality. LFD check surveys, when conducted, will be carried out as per the Standards of Accuracy listed in Table 7.2 of the RSM (unchanged from the previous version). Rejection of any survey results as per the Standards of Accuracy will be made by the LFD Area

Manager after consideration of the types and impacts of the error(s). Recommendations for the suspension of a surveyor's certification may also result.

20. **Tally forms**

Tally forms have been altered slightly to account for the addition of the provisionally FTG category. A change was made to the heading in column # 9 so now it reads "FTG (P or PF)". This was the only change made to the tally sheet.

REGENERATION SURVEY INFORMATION SHEET

Survey Date: _____

Surveyed by: _____

Certification Number: _____

Cutblock Description and Survey Type:

Opening Number: _____

Meridian _____ Range _____ Township _____ Seq. _____

Disposition: _____

Disposition Holder/Operator: _____ Skid Clearance Date: _____

Company Block Number: _____ Field Number: _____

Forest Area: _____

Sub-region: _____

Ecosite:	%	Drainage Class:	%

General Location: North / South
(of the North Saskatchewan River)

Survey Type: Establishment Survey: ☐ Fir Acceptable ☐

Performance Survey: ☐

Wet, Low Density Standard ☐

Classify To: 2000 Standard: ☐ 1991 Standard: ☐

Strata Standard (circle) **C** **CD** **DC** **D**

Survey Grid: _____ (m) x _____ (m) Cutblock Area: _____
Line Spacing Plot Spacing

Survey Results:

Total Plots: _____

Cutblock Stocking %: Total: _____

% Coniferous: _____

% Deciduous: _____

Average deciduous crop tree height: _____

Avg. acceptable deciduous trees/plot: _____

Lower limit density (L.L.) _____

Cutblock Status: **CSR** **NSR** **SR** **FTG** **NFTG**

NSR Area (ha): _____

Roads & Landings Area (ha): _____ % _____

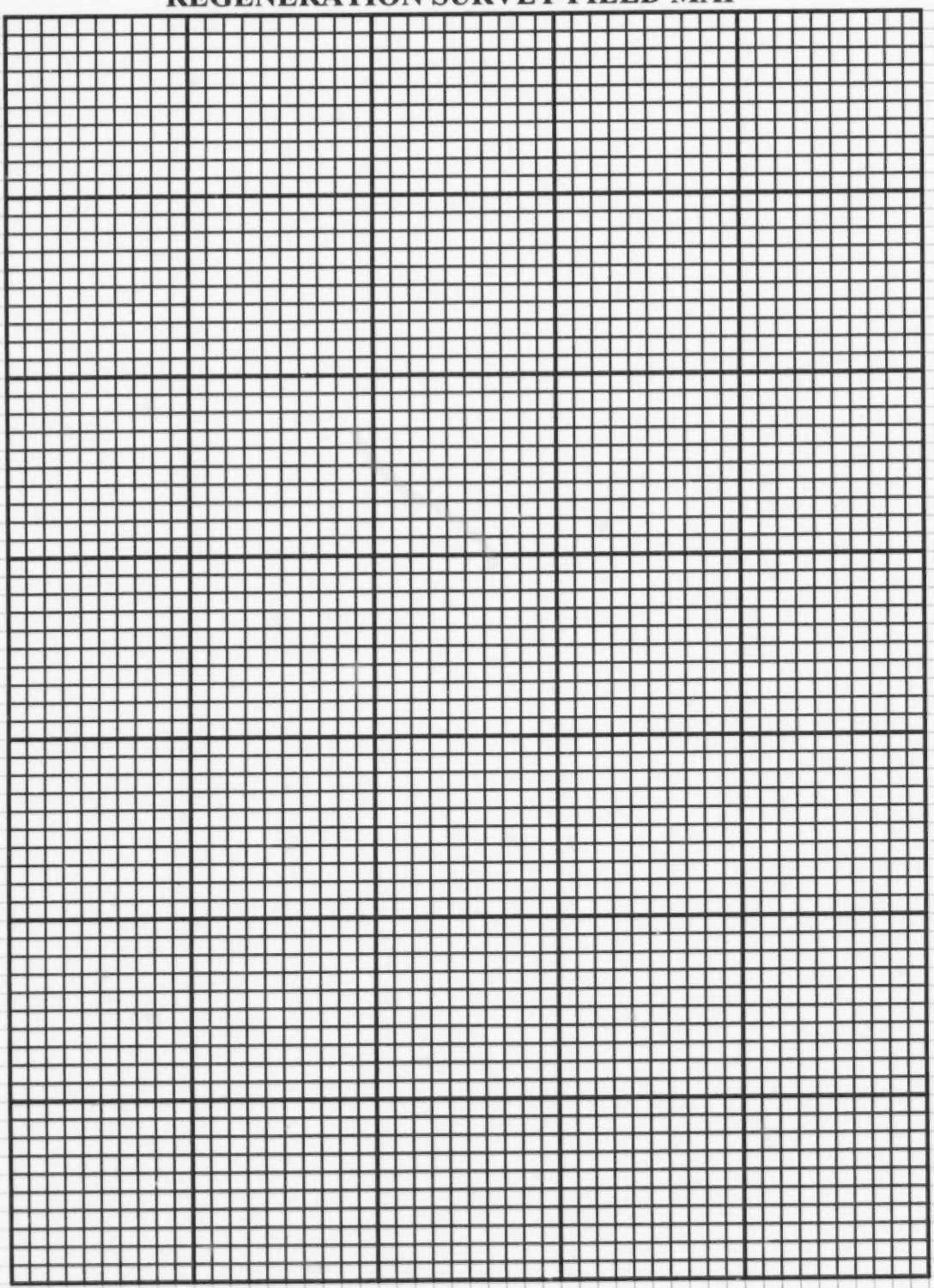
Survey Passes (circle): **C** **CD** **DC** **D**

REGENERATION SURVEY TALLY SHEET

Line No.	Plot No.	Species	Type (SDL, ADV, SC, TC)	Height (cm)	Age (yrs)	RCD (cm)	Selected Crop Tree	FTG (F or PF)	Drainage Class	Capped Acc. Dec. Density	DENSITY 30+ cm No	DENSITY L.L. - 29.9 cm No			
Subtotal:															

Opening Number: _____ Page _____ of _____

REGENERATION SURVEY FIELD MAP



Opening Number: _____ Company Number: _____ Field Number: _____

Scale: _____ NSR Area: _____ SR Area: _____

Tie Point: _____ Control Line Bearing: _____

REGENERATION SURVEY SUMMARY

Damage:	Insect	% Extent	Comments:
	Disease	% Extent	Comments:
	Hare/Rodent	% Extent	Comments:
	Weeds:	% Extent	Comments:
	Other (specif	% Extent	Comments:

Site Conditions:

Treatments Recommended:

Comments:

		# of valid plots	Percent(%)
All Surveys	-not cut or deleted plot		
	-non-stocked **(NSR)**		
	-undersized plots **(NSR)**		
Establishment Surveys	- stocked with acceptable conifer **(SR)**		
	-stocked with acceptable deciduous **(SR)**		
	-stocked with conditional conifer **(SR)** (deciduous survey only)		
	-stocked with both acceptable conifer and acceptable deciduous **(SR)**		
Performance Surveys	- acceptable conifer - NOT Free-to-Grow **(NSR)**		
	-stocked with Free-to-Grow conifer **(FTG) (SR)**		
	-stocked with performing deciduous **(SR)**		
	-stocked with both FTG conifer and performing deciduous **(FTG) (SR)**		
	P - provisionally stocked plot (mark letter P beside plot on diagram)		
	Total:	plots	%

% Coniferous _____

% Deciduous _____

Tree Species Abbreviations:

Sw - White spruce	Pj - Jack pine	Lw - Western Larch	Aw - Trembling aspen
Se - Englemann spruce	Pw - Whitebark pine	Ls - Siberian larch	Pb - Balsam poplar
Sb - Black spruce	Pf - Limber Pine	Fb - Balsam fir	Bw - White birch
Pl - Lodgepole pine	Lt - Tamarack	Fd - Douglas Fir	SH - Shrub (competition)
	La - Alpine larch	Fa - Alpine fir	Ax - Hybrid poplar